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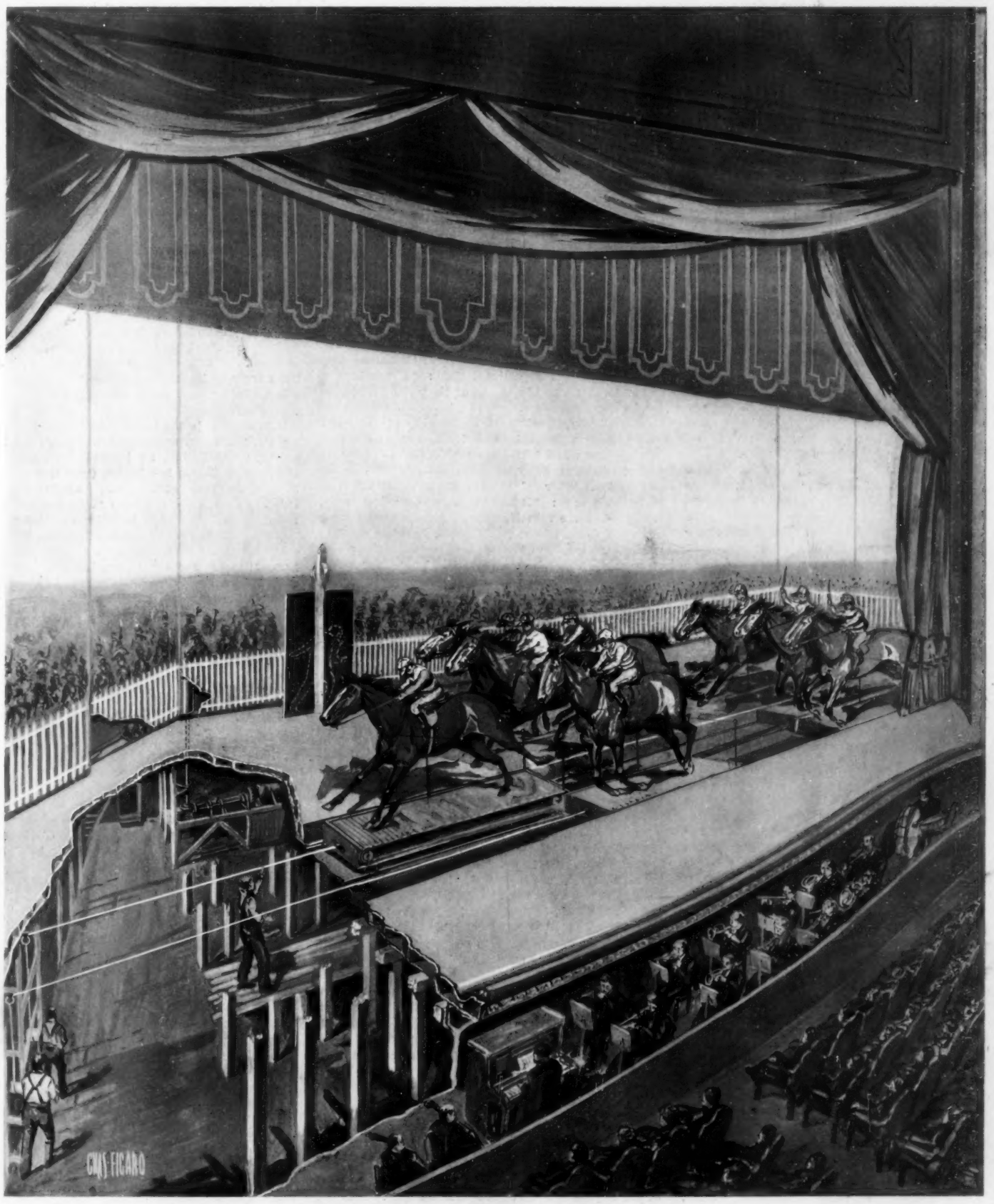


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**THE GREAT HORSE RACE SCENE IN "THE WHIP."—[See page 89.]**

Eight horses ridden by jockeys take part in the race. Each horse runs on a treadmill. That of the winner and one other horse are pulled forward at the finish. Five panoramas (four of them can be moved around the stage) are actuated by individual motors.

# SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## Amend the Panama Canal Act

SUFFICIENT time has elapsed since the passage of the Panama Canal Act last summer for a widespread national discussion of that much debated measure. From platform and pulpit, in the magazine and the daily press, the question of free tolls has been so intelligently thrashed out, that the general public, or at least the thinking part of it, has to-day pretty well made up its mind as to the wise and just course to pursue in extricating the Government from its present admittedly difficult position.

The provision for free tolls, which is the only question in the Act that has been subjected to serious criticism, has been attacked on the dual ground of morals and economics. Our objections on the ground of international morality have been clearly stated, and are well known to our readers. It is not our purpose to enter into that side of the question again; for we believe that, under the new light which has been shed upon the economic side of the question by the report of Prof. Emory R. Johnson, there will be found ample justification for an amendment of the act so far as the canal tolls are concerned—a procedure which we believe would be in harmony with the present state of public opinion and would furnish Congress with a means of dignified withdrawal from its present debatable position.

Without disparaging the weight of the argument based on the moral aspects of the question, we believe that the question of tolls will be fought out and finally settled mainly on economic grounds. Furthermore, we believe that the Senate, in putting the free-toll provision into the act, was moved thereto by a laudable desire to promote, in a just and honorable way, the best interests of American shipping. During the months which have intervened since the passage of the Act, however, two important factors have entered into the problem, which to our thinking have entirely changed its whole aspect. These were the publications of Prof. Johnson's report on the financial side of the question, and the fuller realization of the fact that the leading maritime nations were remitting canal tolls to ships using the Suez Canal, and would probably follow the same course with regard to the Panama Canal.

Prof. Johnson shows that, under existing conditions, coastwise ships sailing between the east and west coasts of the United States are already paying over $4 per ton for the carriage of freight across the Isthmus by the Panama Railroad, and doing a lucrative business at that. He points out that the payment of the $1.20 per ton toll through the Canal would still leave a wide margin of profit for the coastwise trade. The argument is simply unanswerable. It has swept the ground from beneath the feet of those who claim that the tolls should be remitted to coastwise shipping in order to stimulate and develop it. The people of the United States, thanks to Prof. Johnson's analysis, are now perfectly satisfied that the exclusion of foreign shipping from our coastwise trade has given to the latter all the assistance that it can reasonably demand from the Federal Government. There is a widespread conviction that to remit the tolls to these ships alone, would be to make a gratuitous gift of money from the Treasury to private corporations that stand in no need of it whatsoever.

Furthermore, there is a growing understanding, both inside of Congress and outside, that the repeal of this section of the Act will not prevent the Federal Government from rendering financial aid to the American Merchant Marine should it feel disposed to do so; for, if a flat rate is charged on all shipping, domestic and foreign alike, there will be nothing in the much-disputed treaty with Great Britain to prevent the Government from making a remission of tolls, in whole or in part, to American shipping using the Canal, should it see fit to do so. Obviously, the first step in this policy should be the passing of an amendment to the Panama Canal Act by which its present objectionable feature would be removed.

Two bills for the amendment of the Act are now before Congress, one in the Senate, introduced by Senator Root, the other presented in the House by Representative Simms. Their passage will afford a complete escape from the present *impasse*.

It will raise the prestige of Congress to rectify its error by a regular and dignified procedure, which will at once remove the existing misunderstanding with a friendly power, and place the Government in harmony with the best traditions of our National policy. Furthermore, the passage of these bills will save Congress from the humiliation of having to arbitrate a law which lacks the moral support of the country at large.

## Mis-statements in the Oldfield Report

ALTHOUGH no evidence of the actual suppression of inventions was given before the Committee on Patents to which the Oldfield Bill was referred, we find in the report submitted by the Committee, statements which seek to keep alive that false impression and which are in the main misleading. Indeed, the Committee was compelled to go outside of the testimony, which it took, for proof of suppression. In its report it declares: "It has been the subject of comment and complaint in the public press for years. Moreover, many instances can be found in the reports of the decisions of the Federal courts."

Quoting from Columbia Wire Company v. Freman Wire Company (71 Fed., 302, 306) the Committee says regarding one of the parties litigant: "It has become possessed of many, if not all, of the valuable patents for the manufacture of barbed wire and machines for so doing." Examination of the opinion of the court shows, however, that this quotation is merely one clause in a sentence; and that the remainder of the sentence and the context flatly disprove every suggestion of suppression, either of patents or competition. The court really says: "It has become possessed of many, if not all, of the valuable patents for the manufacture of barbed wire, and the machines for so doing, and has granted a large number of licenses to persons and corporations under its said patents. The evidence further shows that it has not bound its licensees to any prices, or in any manner limited or restricted their sales or output. . . . In other words, there appears to be, so far as the complainant's licensees are concerned, unrestricted competition in the sale of their products."

The Committee cites a finding of the court in Indiana Manufacturing Company v. J. I. Case Threshing Machine Company (148 Fed., 21), but fails to publish the fact that the decision in that case was unanimously reversed by the Circuit Court of Appeals of the Seventh Circuit (154 Fed., 365). So, too, the case of National Harrow Company against Bement (21 A. D. N. Y., 290), a decision by a New York court of intermediate jurisdiction cited with approval by the Committee, eventually went to the Supreme Court of the United States, where it was unanimously reversed. (Bement v. National Harrow Company, 186 U. S., 70).

Contrary to the impression conveyed by the Committee's report, the so-called "Lock Case" (Blount Manufacturing Company v. Yale & Towne Manufacturing Co., 166 Fed., 555) did not involve the purchase of patents for "purpose of extinction," but raised the question whether an agreement to restrain trade in respect to both patented and unpatented locks was contrary to the Sherman Anti-Trust Act, and the court, of course, held that it was. Far from indorsing the objects of the substitute Oldfield bill, the court in this case emphatically dissents from the Committee's position, saying: "The right of a patentee to suppress his own rests upon ordinary considerations of property rights. The public has no right to compel the use of patented devices or of unpatented devices, when that is consistent with fundamental rules of property."

The Committee also quotes from the famous "Paper Bag Case" (Continental Paper Bag Company v. Easton Paper Bag Company, 150 Fed., 741; 210 U. S., 405), the opinion of a dissenting circuit judge who differed from the majority of his colleagues and from the decision of the Supreme Court of the United States. This the Committee describes as the "best known instance in the reports of suppression of a patent to prevent competition." This assertion by the Committee is important, because in this case, as the Supreme Court pointed out in its decision, we find a clear instance, not of the willful suppression of a patent, but simply of the rejection of an invention, and a use of a better invention accomplishing the same purpose more satisfactorily.

The conclusion of the Committee that "these citations are sufficient to show that the practice of buying up and suppressing patents is widely indulged" is wholly unwarranted. The contention that the aggregation of patents under single ownership is a monopoly was disposed of by the Court of Appeals of the Seventh Circuit in one of the very cases relied upon by the Committee (Indiana Manufacturing Company v. J. I. Case Threshing Machine Company, 154 Fed., 365, 371) by the following *reductio ad absurdum*: "Their contention comes to this: If he owned either alone, over that he would have complete dominion; owning both, he controls nothing. The public has no right in either invention, therefore, the public has the right to have them both in the market competing for buyers. Naught plus naught; the sum of the two naughts is a substantive quality."

The value of the "comments and complaints in the public press," which the Committee mentions as proving the suppression of inventions, does not merit serious discussion. Not a single instance of such "comment and complaint" is specified in the Committee's report. "I wanted," declared the Chairman, when he presented the report to the House, "to get up as good a report as we could, to make it as plain as possible." Since this is the best showing the Committee can make in respect to suppression of inventions, it is not presumptuous to affirm that present conditions require no change in the patent law upon this point.

## Modern Psychology

PSYCHOLOGY is the study of consciousness. To-day it is a science, a knowing; but this could hardly have been said of it before our era. Psychology is no longer given up to metaphysical speculations, to philosophic inquiry concerning the nature of the soul, the future life, spiritual states, and the like. Such are very legitimate considerations; but they have only an indirect and not an essential relation to modern psychology.

This science, in the present day sense, originated in the work of Weber and Fechner early in the nineteenth century; but it had no independent standing as a science until 1878, when Wundt (who had his eightieth birthday in August of last year) established his laboratory in Leipzig, where so many "experimentalists," both European and American, have been trained. Prof. G. Stanley Hall, in his "Founders of Modern Psychology," considers that "psychology owes to Wundt a debt far greater than to any other man, living or dead." Presently Müller, Martius and Ebbinghaus followed Wundt's example in Göttingen, Bonn, and Berlin, respectively: within fifteen years sixteen experimental laboratories were established in America, all directed by Americans, except that presided over by Münsterburg at Harvard. And at Harvard the lamented William James prepared his superb treatise, the reader of which readily subscribes to the *mot* that "William James, the philosopher, writes like a novelist, while his brother, Henry, the novelist, writes like a philosopher."

Psychology is now an eminently practical science; and its development has been so great that it has in its turn become divided into branches—or shall we not say distinct sciences. These are the physiological psychologists, who devote themselves exclusively to work upon the anatomy, histology and physiology of the brain, the organ upon which mind is conditioned and in which mind manifests itself most. Then there are the experimental psychologists, who get their data at first hand from study of the conscious, sentient being, human or animal or plant; these experimentalists seek to correct the irregularities and errors of individual observers by objective tests. They eliminate, as far as possible, the personal equation, by the use of accurate instruments in testing data. They deal with a very wide range of problems, as witness one of their meeting programmes: the differential perception of colors in the spectrum; geometrical illusions; the influence of rhythm upon the circulation of the blood; the influence of such substances as tea and hashish on psychic processes; the psychology of the telegrapher; respiration in relation to attention; the development of voluntary motion in the child; the mental faculty and sensation measurements in school children and university students; variation in the nests of the spider; measurements of the variability of instinct; the psychology of the ant queen; the sense and intelligence of the Japanese dancing mouse, etc.

Obviously modern psychology is an important science, because it seeks to measure and to normalize consciousness, that is, psychism or mentality. Thus psychology is really the handmaiden of all the sciences; because all valid scientific conclusions are achieved only through sound mentality.

## Engineering

**A Turbine- and Reciprocating-engine Competition.**—What a fine opportunity for judging the relative efficiency of the turbine and the reciprocating engine was afforded by the recent run of the "Arkansas" and "Delaware" from Colon to Key West at a speed of 18 knots. The reciprocating engines of the "Delaware" have some fine records to their credit, and since the "Arkansas" is fitted with the latest type of turbine, the run should afford some excellent and most valuable data as to the relative efficiency of the two types, at least at a speed of 18 knots.

**Removing Railroad Grade Crossings.**—In view of the growing number of fatalities at grade crossings, the Legislature of New York State should give favorable consideration to the recommendation of the Public Service Commissioner of the Second District that $500,000 be appropriated for eliminating grade crossings of highways and steam railroads. It will surprise some of us to learn that there are at the present time over eight thousand of these crossings in the territory which is covered by the Commission of the Second District alone.

**Solidifying of the Gatun Dam.**—According to that excellent publication, the *Canal Record*, the hydraulically-deposited core of the Gatun dam is now practically covered in by the dry fill. The deposited material is a smooth clay, highly waterproof, which has flowed into every interstice in the rock and earth, until the whole mass at the center of the dam has become like a rubble wall, every rock of which is cemented to another. This clay is similar to the blue rock found everywhere on the isthmus, and the *Record* states that it is probable that in time the core of the dam itself will solidify into such rock.

**One-man, Gun-fire Control.**—The ideal method of firing broadsides from a battleship would be one in which all the guns were given the same training and pointing, simultaneously by one man—provided of course, he is possessed of better training and elevating abilities than the average of the ten or a dozen separate men who do the work at present. Sir Percy Scott has perfected a system by which all the guns can be trained and elevated simultaneously by one man from a given station. The latest report states that this method has shown a great superiority in target practice over the old system of separate pointing and training.

**Large Dipper Dredges.**—The excavation of the Atlantic entrance to the Panama Canal called into service dipper dredges of unusual size and capacity. The "Mindi" and "Chagres," which are cutting the entrance channel to a minimum depth of 42 feet at mean tide, are working entirely in rock which has been previously broken up, and they bring the material to the surface in 5-yard dippers. The dipper handles are 62 feet in length and the boom supporting the shipper shaft is 50 feet long. To facilitate the work the dredges have been equipped with steam dipper trips which have shown good results during six months of work.

**High-speed Trains in Germany.**—The 1912 summer-time table of the German Railway Systems, says *The Engineer*, provides an interesting study, for it reveals that a new era of rapid transit has dawned in that country. In 1911 a non-stop run from Berlin to Hamburg in three hours and twenty minutes was inaugurated, and in 1912 the run was further accelerated. The train left Berlin at 8:55 P. M., reaching Hamburg, 178¼ miles distant, at 12:09 A. M., the speed being 55.1 miles per hour. The return journey was made at 54.5 miles per hour. The train was a light one, consisting of four four-axle carriages and a six-axle dining car.

**Safety Railroading.**—The Pennsylvania Railroad, cooperating with other lines in the eastern territory, has inaugurated a railroad safety movement, which is the latest move of many made by the company to increase the safety of passengers and employees on its system. "Safety First" meetings are to be held in several important centers, in which lectures illustrated with photographs, lantern slides, and statistical tables will be delivered. We are glad to note that other leading railroads are moving in the same direction, for we regard this "Safety First" movement as one of the most effective agencies for reducing our present shocking annual railroad list of killed and injured.

**The Gas-electric Motor Car.**—Railway officials have been watching with interest the development of the self-propelled car for use on steam roads. Under steam operation, short branch lines, carrying a limited traffic, are notoriously unprofitable. Single units running at sufficiently frequent intervals give a more satisfactory service than the larger once-a-day trains; and the managers have turned to the self-propelled car as offering a solution of the problem. To-day over twenty railroads have self-propelled units of the gas-electric type running on regular local schedule. The consumption of gasoline, while varying with the local conditions, is found on the average to be low, the economy being due to the electric transmission, which lends itself admirably to the particular requirements of local service.

## Science

**A Yearbook of Agricultural Statistics** is the latest periodical publication to be undertaken by that remarkably prolific institution, the International Institute of Agriculture. The initial volume, published in 1912, gives statistics for the years 1901 to 1910 from the fifty countries adhering to the Institute, representing practically the whole of the civilized world. All the data are from official sources.

**The Rice-growing Congress.**—The fourth international congress of rice growing was held at Vercelli, Italy, during the early part of November. It was decided to establish an international center for rice cultivation and researches upon this subject, and accordingly the Vercelli rice-growing plant is to be rearranged and laid out with this end in view. The institution will be directed by Prof. N. Novelli, and it is expected to further the interests of this branch of research to a considerable extent.

**Feeding Plants to Keep Them Warm.**—It is well known, of course, that human beings and the lower animals are better able to resist cold when they are well fed, but it is interesting to learn that a German investigator has announced that feeding plants has the same effect on them. He declares that the introduction of organic substances of nutrient character (carbohydrates, alcohols, acetone) into the plant cell heightens its resistance to cold, even in the case of tropical plants. Different substances protect in different degrees. The sugars stand highest, then come glycerine, the alcohols, and acetone. The removal of the protective contents restores the original degree of resistance.

**Amundsen Receives a Gold Medal from Peary.**—On January 11th Capt. Roald Amundsen, discoverer of the South Pole, received from the hands of Rear-Admiral Robert Peary, discoverer of the North Pole, the gold medal of the National Geographical Society. Replying to the brief speech of presentation, Capt. Amundsen said: "Greatly as I am honored by receiving this beautiful medal, I feel that the honor is multiplied a thousandfold by the fact that the presentation has been made by the greatest explorer since Christopher Columbus. The desire to search out the South Pole, in fact, the spirit for exploration and discovery, was awakened in me by Admiral, then Lieut., Peary, whom I met in the Arctic in 1890."

**Right and Left Handed Plants.**—Do you know that there are right handed plants and left handed plants? An English investigator, R. H. Compton, has thought the matter curious and interesting enough to make it the subject of extended investigation, and has reported on it to the Cambridge Philosophical Society. He observed eight varieties of two-rowed barley to determine the ratio of rights to lefts; in the first, leaves of seeds of different varieties and of the various kernels from the same individual spikes, and found that among 12,401 seedlings 7,237 or 58.36 per cent had the first leaf twisted to the left. A variety of millet showed an excess of left handed seedlings, as was also the case with oats. In the case of corn, the ratio was almost unity, and there was apparently "no inheritance of right and left handedness as such."

**The Meteorological Service of Brazil** has been completely reorganized and placed under the Ministry of Agriculture, Commerce and Industry of that country. About 150 stations are already in operation, and it is planned to greatly increase this number by having each State establish a central observatory and a local network of stations to cooperate with the central institution in Rio Janeiro. Several stations will soon be established in the remote interior, at places to which access is slower and more difficult than a journey to Europe. At present nine tenths of this vast country is a meteorological *terra incognita*, representing a deplorable blank on the climatic charts of the globe. The shining exception to this condition of affairs is the famous coffee-producing State of São Paulo, which has long maintained an excellent meteorological service on its own account. The director of the new national service is Prof. Dr. Henrique Morize.

**Expedition to the Karakoram.**—Dr. Filippo di Filippi, well known as an associate of the Duke of the Abruzzi in his mountaineering enterprises, is preparing to lead a scientific expedition to the Western Himalaya and the Karakoram, which will probably be the most important undertaking of its kind ever conducted in that region. The proposed route lies from Kashmir over the Himalaya range and through Baltistan and Ladakh into Chinese Turkestan. The problems to be investigated concern topography, geology, gravity, magnetism, and meteorology, including the various forms of radiation and atmospheric electricity. The upper air is to be sounded with kites sent up from stations of high altitude—a particularly interesting undertaking, for the reason that the Himalayan explorer will be able to start his kite at a level corresponding to the greatest heights above sea-level heretofore attained by the kite itself in other parts of the world. The estimated expense of the expedition is $50,000, of which $30,000 has already been raised.

## Aeronautics

**A New Height Record in an Aeroplane.**—On January 10th Maurice Chevillard made a new world's record for three passengers. He rose to a height of 4,921 feet. The ascension was made at Buc, France.

**A Life Saver for Airships.**—Francois Rilleau, of Los Angeles, Cal., has patented, No. 1,046,023, a safety device for airships in which a collapsible parachute cover is opened by a spring, and frames fastened to the airship fold over the parachute cover and are held by a latch to secure the parachute out of operation until necessity for its use arises.

**A Novel Envelope for Aerostats.**—John R. Gammeter, of Akron, Ohio, has patented, No. 1,047,038, an envelope for gas containers, for aerostats, composed of a fabric woven of metallic ribbons, and he forms this envelope with a body portion of tightly woven metallic ribbons and with end portions of sheet metal, the ribbons being woven so that they present substantially no interstices.

**Flight Across the La Plata River.**—A remarkable flight of 120 miles over water was made from Buenos Aires to Montevideo on the 2nd inst. by Corporal Fels. The distance covered was 120 miles and the time of the flight something over two hours. The flight was made down the river, which is 80 miles wide at its mouth. The young corporal is a student of engineering who is doing one year of military service. He pilots a Blériot monoplane.

**Curtiss Flying-boat for the Army.**—The flying-boat built by Glenn H. Curtiss has been successfully tested at Hammondsport, N. Y. In the climbing test, the machine rose to an altitude of 1,200 feet in 6½ minutes. The average speed was 54.8 miles an hour in a 10-mile wind blowing diagonally across the course. During a two-hour duration test, a total weight of 900 pounds was carried, which included the weight of the aviator and passenger.

**Testing the Twin-engine Principle.**—According to *Flight*, Lieut. Seddon on the Short twin-engine biplane recently rose from Eastchurch to a height of 6,400 feet. Then coming down to 900 feet he cut off one engine, and made a flight of about 9 miles to the south of Sheppey and Leysdown, finishing up with a volplane from 500 feet. It has been stated, as a result of this experiment, that should one motor fail at a height of 5,000 feet, the machine would be able to travel a hundred miles without alighting on the water.

**An Air Scout Killed.**—According to a dispatch published in the New York *Times*, a war aviator, Dr. Jules Constantin, with the Bulgarian army was killed in battle. On his final flight he left Furna, a small village before the Tchapalia lines, in a biplane, and rapidly disappeared from view. When the machine returned and descended, his comrades found him lying dead on the ground with a wound in his chest. The wings of his biplane were riddled. His barograph showed that he had attained a height of 4,000 feet above the Turkish forts. He had just enough strength left to guide his machine toward the Bulgarian camp.

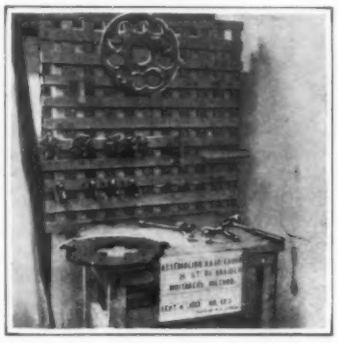
**Italian Aviation.**—The Italian army is coming to the front in the use of hydroplanes, and among other performances we may mention the brilliant flights made by Lieut. Ginnocchio upon his Paulhan machine, at Venice, alighting at times amid the numerous gondolas. Paulhan, who was on a visit there, also made flights before the Italian officers. The government is taking up the hydroplane question very actively, and is installing aeroplane posts all along the coast. It intends to use Borel hydroplanes quite extensively, and has ordered nine of these to be delivered to the Venice arsenal in three months. The first hydroplane fleet is now setting out to make over-sea flights, and the pilot Chemet is to make evolutions over the Adriatic. On the other hand, the Austrian war department has just ordered one of the newest Paulhan-Curtiss hydroplanes, known as "flying boat."

**Hydrogen for Military Dirigibles.**—The production of hydrogen for the airships of the war fleet is organized on an extensive scale in Germany. All military airship headquarters have their own hydrogen plants located in the vicinity, so there are now twelve plants of the kind. At Altona, near Hamburg, there is a station near the sea coast for airships which are in use with the navy, and the centers of Berlin and Frankfort have each two hydrogen plants. Six of the stations lie along the west frontier. The new hangar constructed at Frankfort, especially for the airship "Victoria-Louise" of the Zeppelin type, receives hydrogen direct from the Griesheim chemical works by a pipe line 2.7 miles long, which is the first of the kind in Europe. Using high pressure, the delivery of gas per day is as much as 30,000 cubic feet. Autogenous welding is used for the pipes so as to prevent any leakage of gas. The pipe line ends in a gas holder of 200,000 cubic feet capacity, and upon it are eighteen separate outlet taps for taking off gas for the airship's use. As these outlets are situated in the hangar itself, it is an easy matter to fill out all the ballonnets of the airship at the same time.

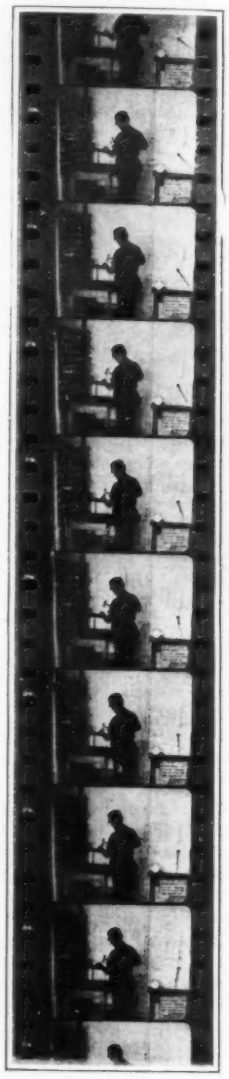
Part of a film, showing motions in assembling a braiding machine.

The Gilbreth chronometer.

*At the December meeting of the American Society of Mechanical Engineers a remarkable development in scientific management was disclosed during the discussion of the report of the sub-committee on administration. As will appear from the following article, the development consists in using the moving picture camera to record the number of motions made and the time consumed for each.*—EDITOR.



One of the experimental packets.



Part of a film, showing motions made in using hammer.

# Micro-motion Study

## A New Development in Efficiency Engineering

IN almost every book on efficiency engineering much space is devoted to what is called "motion study." The number of motions made by a workingman or a tool and the time occupied in performing these motions are accurately determined so far as possible. Hitherto the time element has been controlled by means of a stop watch in the hands of a trained observer—no easy task when it is considered that very often hundreds and even thousands of motions and operations must be studied and timed. The more expensive the study, the more likely are errors to creep in.

In order to reduce the labor involved in these painstaking investigations, and above all to eliminate the possibility of error, Mr. Frank B. Gilbreth, a very well-known efficiency engineer, who has made a specialty of motion study, has invented an entirely new method, which consists in using a moving picture machine in connection with a special chronometer or "clock," as it is termed in the parlance of scientific management.

At the December meeting of the American Society of Mechanical Engineers, Mr. John G. Aldrich of Providence and Mr. Robert Thurston Kent of New York revealed this new method in all its details. So interesting was the subject that it was discussed during an entire session of the Society on a Friday morning and during a supplementary session which lasted until late into the afternoon.

Mr. Gilbreth's special clock makes ten revolutions per minute. Its dial has one hundred divisions, each of which, therefore, represents a time interval of one one-thousandth of a minute.

In studying the motions required to assemble a machine, for example, the chronometer plays as important a part as the object studied. It appears prominently in every one of the hundreds of pictures taken by the moving picture machine. Alongside the chronometer, an ordinary twelve-hour clock, which fixes the time of day, is placed so that in the moving picture film, complete information regarding the time study is included.

Every film reveals the successive positions of a workman in performing each minute operation of the task intrusted to him. The position of the chronometer pointer in successive films indicates the length of time between successive operations. These films are studied under a microscope, and a careful analysis of each operation is made to develop the standard time for each. The interval between the successive films in one study was a little under three one-thousandths of a minute. Obviously such accurate time studies of minute and detailed operations can hardly be made by means of a stop watch. Fine as that study was, it can be made much finer. Chronometers can be used which make one revolution in one thirtieth of a minute, and the dials being divided into hundredths, it is possible to obtain time studies of greater refinement than at present appear necessary. "Micro-motion study" is the name which has been given to this method of recording and studying minute motions or parts of motions. The film is far more than a record of time. In the discussion before the American Society of Mechanical Engineers, it was pointed out that it will serve as an instruction card which may be enlarged and passed from workmen to workmen to teach the best methods of doing work. A film shows a workman not only what to do, but how to do it to the last detail, and, therefore, teaches him what printed instructions and books can never impart adequately. It also shows him the time which the most skilled workingman required for a given piece of work, and which can be equaled if that workingman's motions are mimicked.

Any workman may, for a time, deceive an inexperienced efficiency engineer by "soldiering." But the camera cannot be deceived. The film records faithfully every movement made, and subsequent analysis and study reveals exactly how many of these movements were necessary and how many were purposely slow or useless. Hence by the elimination of the useless movements a most economical method of performing a given piece of work can be attained.

In the Providence works of which Mr. John G. Aldrich is vice-president and general manager, experiments in micro-motion study were made, which involved the assembling of braiding machines. Originally the parts were assembled by bringing them to the job in boxes, from which they were taken by the worker, as he required them, and assembled at an ordinary work-bench. In transferring the individual pieces to the growing machine many motions were unnecessarily made, all of which were disclosed by the moving picture machine. One result of this micro-motion study of assembling braiding machines was the provision of a bench which brought the top of the completed machine at a convenient level for the workman, and the arrangement of the parts in an orderly manner in bins behind him. Although the number of motions was thus considerably reduced, there were still more than were absolutely necessary. Experience in other trades has shown that it is often desirable to group units composing a single assembly on a "packet" and to arrange them in the order in which they are needed. A similar packet scheme was adopted for the parts of the braider.

The moving picture camera photographing a workingman's motions. Note the clocks.

First a horizontal packet was made up and the motion picture machine disclosed an irregularity and lack of rhythm in the movements of assembling, which seriously cut down the efficiency of the workmen. Then a vertical packet was tried and a standard type of portable assembly bench was thereby indicated. After a few experiments a highly efficient arrangement was devised. The various parts were hung on pegs in the exact position that micro-motion study had revealed as the most economical of motions both as regards time and length of travel. Thus the method permitted the development of the finally accepted method in a small fraction of the time and expense which would have been necessary under the conditions which existed before its invention.

### Sawdust Briquettes

A NEW industry may be successfully combined with the planing mills—that of making of the sawdust briquettes to be used for firing under the boilers, thus considerably decreasing the cost of the fuel to the mill owner. This is being very advantageously done in Germany. The sawdust is automatically gathered and conveyed to a place near the presses. From here it is carried over a heated belt-conveyer to a drying-room. This is a cylindrical revolving drum about 2 feet in diameter and 20 feet long. In this drum the sawdust is partially dried, the pitch contained in the wood is softened, acting hereafter as a binder. From here the sawdust is conveyed over an incline to the after-dryer of the same shape as the first dryer, which forms a part of the press. Here it is submitted to a higher temperature to drive off all the moisture, and kept running forward toward the end of the after-dryer by rotating paddles. At the end of this after-dryer, the sawdust falls through an opening into the trough of the press, which is a simple angle-lever press. The drive is of the usual shifting belt type, the fixed pulley acting as a flywheel. At the end of each pressing operation, which takes places about 24 times a minute, a briquette is made about 5½ inches by 2⅞ inches by 1¼ inch, weighing between one half and three quarters of a pound. From the press the briquettes are carried by another belt-conveyer to a cooling room and are then ready for use. As the installation is very cheap, costing in Germany only $24, it should recommend itself to the attention of sawmill owners, who could utilize to great advantage a heretofore mostly wasted product of their mills.

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**Russia Forbids Crossing of Frontier in Aeroplane or Airship.**—The Russian Cabinet recently issued an order prohibiting foreign balloonists and aviators from crossing the western frontier for six months.

# Morning and Evening Stars for 1913

## Graphic Representation of the Planets and Their Movements During the Year

By Professor Frederic R. Honey, Trinity College

THE changes in the relative positions of the planets as exhibited every year in "Morning and Evening Stars," afford a pertinent illustration that in nature there is no such things as repetition; and while a supreme law pervades and controls every variation in planetary positions, yet each planet yearly occupies a different place in its orbit, and in relation to its fellows, producing conditions which are always unique in planetary combinations. The presentation of "Morning and Evening Stars" thus includes an opportunity to locate each planet, and incidentally to review annually the principal elements of the Solar System.

### The Sun.

The sun, whose mass is about seven hundred and fifty times the sum of the masses of all the planets and their satellites, is a sphere whose diameter is 864,367 miles. It rotates on its axis in about twenty-five days in the same direction as that of the revolution of the planets in their orbits. Some idea of the great magnitude of the sun may be obtained by comparing its diameter with that of the moon's orbit which is 477,702 miles. The sun is the only body in our system whose dimensions would be appreciable in the plot of the terrestrial planets, in which it would be represented by a circle whose diameter is less than one hundredth of the radius of the earth's orbit. At a distance of nearly ninety-three million miles, the sun's diameter subtends an angle of a little over ½ degree. At this distance the prominences which are visible during a total eclipse do not appear—the outline being that of a circle which may be represented to the observer by a disk one inch in diameter at a distance of about nine feet from the eye.

### The Planets—Kepler's Laws.

The planets are conveniently studied in three groups—the Terrestrial planets, the Asteroids, and the Major planets. Since the radius of Neptune's orbit is between seventy-seven and seventy-eight times that of Mercury it is impracticable to represent the orbits of all the planets in one plot. The orbits of the terrestrial planets are drawn to as large a scale as the limits of the page admit; and those of the major planets are necessarily plotted to a scale which is very much reduced. The great difference in the scales is evident by a comparison of the orbits of the earth and Mars in the two plots.

The plane of the ecliptic, which is the plane of the earth's orbit, is represented by this page, which for convenience of reference may be placed in a horizontal position. A planet may be described as above or below this plane; but it should be understood that this description is simply to aid the imagination, since there is no such thing as horizontal and perpendicular, or above and below in stellar space.

The planes of the orbits of the terrestrial and major planets form small angles with the plane of the ecliptic. The intersection of the plane of a planet's orbit with the ecliptic is the line of nodes; and the point *N* where the planet passes from the space below to that above the ecliptic is the ascending node; *N'* is the descending node. Perihelion or point of nearest approach to the sun is at *P*.

### The Terrestrial Planets.

#### MERCURY.

On account of the great eccentricity of the orbit, the planet illustrates more vividly than any of the terrestrial or major planets, the first two of Kepler's laws of planetary motion. 1. The orbit of each planet is an ellipse with the sun at one focus. 2. The radius of the orbit sweeps over equal areas in equal times. The center of Mercury's orbit is at *b*, at a distance from the sun of a little over one fifth of the mean distance between the sun and Mercury; and the area of the triangle with that part of the orbit between the positions at the dates August 22nd and August 30th, with the sun as a vertex, is equal to the area of the triangle with the same vertex and a base equal to that part of the orbit between the dates October 1st and October 9th. The planet accomplishes its revolution in very nearly 88 days (87.97) and the positions are shown at intervals of two days. In order to avoid confusion the date is attached only for every eighth day. Mercury's orbit is inclined to the ecliptic at an angle of 7 degrees. The mean distance from the sun expressed in terms of the earth's mean distance is 0.3871; the period (88 days) = $0.^{y}2408$; and $\overline{0.3871}^3 = 0.05798 = \overline{0.2408}$ ; illustrating Kepler's third law, viz.: The squares of the periods of any two planets are proportional to the cubes of their mean distances from the sun. The orbital velocity of the planet is subject to great variations. At perihelion it moves at the rate of 35 miles a second; at aphelion the velocity is reduced to 23 miles a second.

#### VENUS.

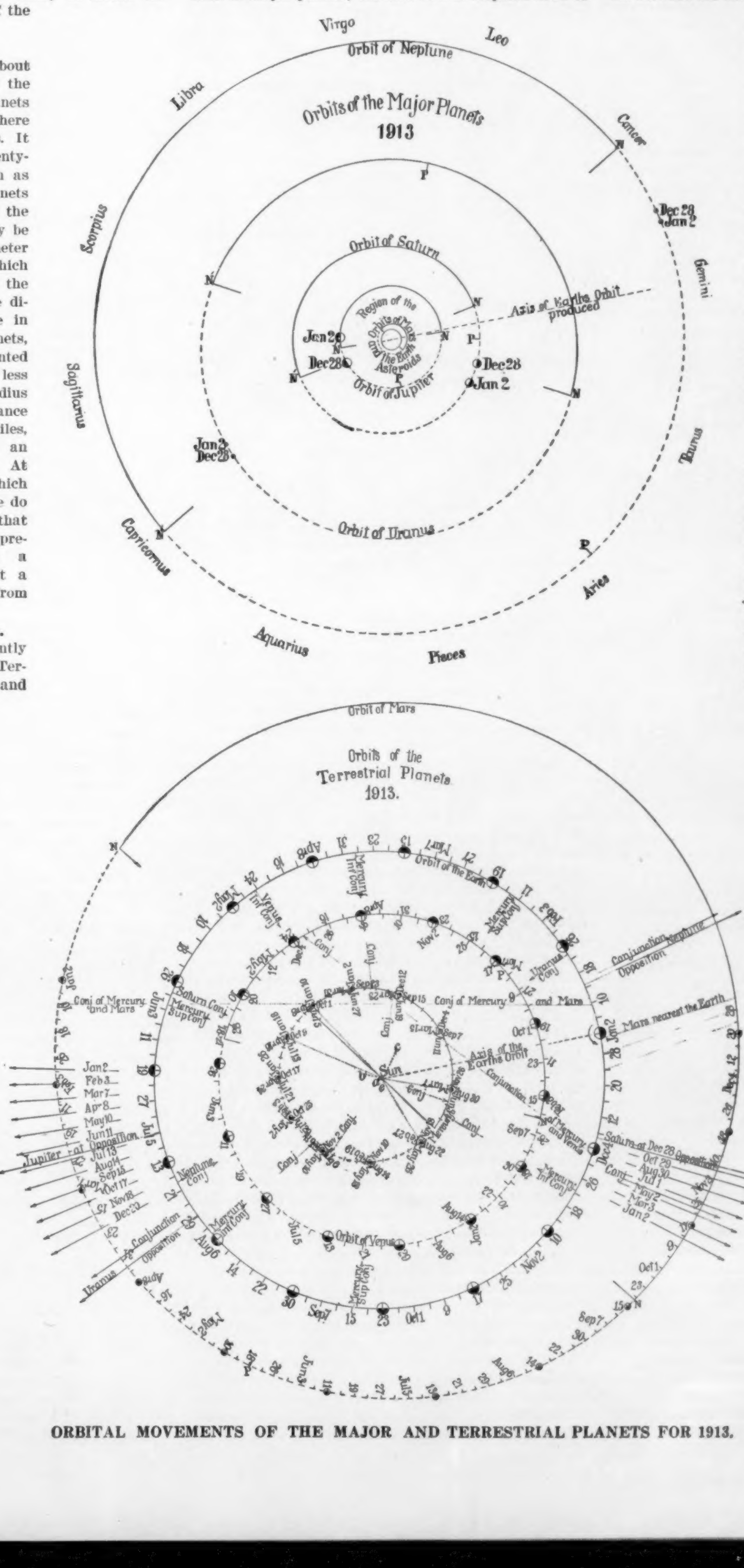
The eccentricity of the orbit is less than that of any of the terrestrial or major planets, its linear measurement being so small that it is scarcely visible in the plot. As a consequence Venus moves in a very nearly circular orbit at an almost uniform velocity of 21.9 miles per second. The plane of the orbit is inclined at an angle of nearly 3.4 degrees; and the planet's mean distance from the sun is equal to 0.723 times the earth's mean distance. The period of revolution is 224.7 days, and the position of Venus is shown at intervals of four days. On August 14th the planet very nearly reaches the position of January 2nd. The distance between these positions is that traversed in seven tenths of a day. The dates for the first revolution are attached without the orbit; those for the second revolution within the orbit.

#### THE EARTH.

The center of the earth's orbit is at *a*; its eccentricity *e* representing a little over 1½ million miles. Thus in January our planet approaches more than three million miles nearer the sun than in July. At a mean distance from the sun of 92,894,767 miles the earth performs its revolution in 365.25 days, at a mean velocity of 18.5 miles per second. The positions are shown at intervals of four days.

#### MARS.

The great eccentricity of the orbit brings the center c at a distance from the sun equal to nearly one tenth of the mean distance of the planet. The plane of the orbit is inclined at an angle of 1.85 degrees. At a mean velocity of 15




ORBITAL MOVEMENTS OF THE MAJOR AND TERRESTRIAL PLANETS FOR 1913.

miles per second, and at a distance equal to 1.5237 times the earth's mean distance, Mars completes a revolution in 1.88 years. The positions are shown at intervals of four days.

### The Asteroids.

For the purpose of this article it is not necessary to do much more than refer to these fragmentary bodies occupying the space between the orbits of Mars and Jupiter. The elements of the orbits of seven hundred and fourteen of the planetoids have been tabulated, and the number is continually increasing. Some of the orbits show great eccentricity, and are inclined at large angles to the ecliptic. The distances of four of the most remote of these bodies do not differ very much from Jupiter's distance; and the orbit of Eros, whose period is even a little less than that of Mars, on account of its great eccentricity, comes very near the earth's orbit.

### The Major Planets.

JUPITER.

At a distance from the sun equal to 5.2 times the earth's mean distance, Jupiter makes a revolution at the rate of 8.1 miles per second in 11.86 years. The eccentricity of the orbit, which is inclined at 1.3 degrees to the ecliptic, is a little over one half that of Mars. The direction in which the planet would be seen from the sun is shown in the plot at intervals of 32 days.

SATURN.

Saturn's orbit, which is inclined at 2.5 degrees, shows a greater eccentricity than that of Jupiter. The ringed planet's distance from the sun is a little over nine and a half times the distance of the earth; and its revolution around the sun, at a velocity of six miles per second, requires 29.46 years.

URANUS.

The orbital eccentricity of this far distant planet is very nearly equal to that of Jupiter; but on account of its remoteness from the sun (which is 19.19 times the earth's distance) the linear eccentricity, or actual distance from the sun to the center of the orbit, is nine tenths the earth's orbit radius. The inclination of the orbit is only ¾ degree, less than that of any of the orbits of the terrestrial or major planets. At a velocity of 4.2 miles a second, Uranus completes a revolution in 84.15 years.

NEPTUNE.

The outermost planet, whose distance is 30.07 times the earth's distance, has a velocity of 3.4 miles per second, which on account of the small eccentricity is nearly uniform. The orbit is inclined at an angle of 1.76 degrees, and the period is 164.79 years. In common with all the planets Neptune conforms to Kepler's three laws of planetary motion.

### Conjunctions and Oppositions.

The positions of the planets are shown in the plots at Greenwich noon. The hour of the day when a conjunction or an opposition occurs is indicated by the measurement on the orbit.

TABLE I.—GREENWICH TIME.

| Date. | Conjunctions. | Oppositions. |
|---|---|---|
| January 14 | | Neptune |
| January 23 | Uranus | |
| February 12 | Mercury (sup.) | |
| March 27 | Mercury (inf.) | |
| April 24 | Venus (inf.) | |
| May 29 | Saturn | |
| June 1 | Mercury (sup.) | |
| July 5 | | Jupiter |
| July 18 | Neptune | |
| July 28 | | Uranus |
| August 4 | Mercury (inf.) | |
| September 16 | Mercury (sup.) | |
| November 22 | Mercury (inf.) | |
| December 6 | | Saturn |

Mars comes nearest the earth on December 31st; but the planet will not come to opposition until January 5th, 1914, when on account of the eccentricity of the orbit, Mars will be a little farther from us.

### Conjunctions of the Planets.

Twelve conjunctions of the planets occur during the year. Only two are illustrated—those of Mars and Mercury, and of Mercury and Venus. The others may be discovered by the reader with the aid of a straight-edge, which should be applied to the earth and the planets at the dates given in the table.

TABLE II.

| Date. | Planets. |
|---|---|
| January 9 | Mercury and Mars |
| January 11 | Mercury and Jupiter |
| January 13 | Mars and Jupiter |
| January 31 | Mercury and Uranus |
| February 25 | Mars and Uranus |
| May 8 | Mercury and Venus |
| May 31 | Mercury and Saturn |
| June 23 | Mercury and Neptune |
| July 21 | Venus and Saturn |
| August 24 | Mars and Saturn |
| August 29 | Venus and Neptune |
| December 2 | Mercury and Venus |

### How to Find Morning and Evening Stars.

Place the accompanying plot of the terrestrial planets in such a position that the earth at the assigned date is between the reader and the sun. The dates attached to the earth, Mercury, Venus and Mars, may then be seen without turning the head. A straight-edge passed through the earth and the sun will divide the planets into two groups. Since the earth rotates in the directions of the arrow (see position for January 2nd) the observer emerges at sun-rise from the shadow area, and the planets on the right rise before the sun and are morning stars. At sun-set the observer enters the shadow area; and the planets on the left of the plot as inspected, set after the sun and are evening stars. Between inferior and superior conjunctions Mercury and Venus are morning stars; and between superior and inferior conjunctions these planets are evening stars. Before conjunction a planet whose orbit is outside the earth's orbit is evening star; after conjunction it is morning star. When a planet is at opposition it is above the horizon before and after midnight, and is both morning and evening star. Following this method the morning and evening stars for any day of the year may be ascertained.

## The New York Automobile Shows

NOW that the Selden patent is a thing of the past, the two big automobile shows which have generally been held heretofore by rival interests were this year—the thirteenth of these exhibitions—conducted under one management. The National Association of Automobile Manufacturers spared no expense to make the 1913 shows the best yet, and in the Grand Central Palace show so elaborate were the decorations that the walls were covered with specially painted woodland scenery.

Practically all the cars exhibited this year have two distinct improvements—motor starters and electric lights. The self-starters are of several kinds, ranging from a coiled spring to acetylene gas, which is pumped into the cylinders and exploded by a spark, but the most popular device of this kind at present is the electric, in which a small electric motor placed beside the flywheel carries a pinion that can be meshed at will with teeth cut on the periphery of the wheel. Current from the 6-volt or higher storage batteries, drawn at the rate of 150 amperes or more for a few seconds, causes the motor to make the few revolutions sometimes necessary to start it. This current is restored to the batteries later by the motor acting as a dynamo, or by a separate charging dynamo used on some systems.

By far the neatest electric self-starter consists of an 8-pole ring-armature motor, the armature of which forms the flywheel of the gasoline engine. Thus the hundred pounds or more of extra dead weight is eliminated. One starter has the electric motor mounted in front of the radiator and driving the crankshaft through a worm gear. Another consists of an opposed cylinder air motor similarly situated. But as a rule the mechanism is concealed, and the only indication that a car is so equipped is a cap on the end of the crankshaft. This can be unscrewed and a starting crank applied if for any reason the self-starter fails.

Given a charging dynamo, the installation of an electric lighting system is an easy matter. Electric headlights are more powerful than acetylene lamps, besides giving a perfectly steady and white light. The tungsten-filament lamps are also economical of current, which is generally supplied by a 6-volt storage battery. The Westinghouse system makes use of the frame of the car in place of a return wire, thus cutting in half the amount of wiring and simplifying greatly the detection of any trouble. Closed cars are fitted with dome lights in the ceiling, as well as with interior antique lanterns in some instances. Many have dashboard lights to illumine the various meters and gages at will, and in one instance the push switches for all lights were arranged on a panel just below the steering wheel. In the majority of cars, the usual side lamps are dispensed with and two bull's eye electric lights are placed in the dashboard.

The upholstery on the 1913 cars is better than ever before; the cushions are thicker; and everything has been done for comfort. On some high-priced cars cushions 10 and even 14 inches thick are used.

Shock absorbers are fitted to a few machines, but they are not part of the regular equipment as a rule. There have been one or two new types of springs introduced, but no maker has adopted a substitute for springs such as the Cox pneumatic cushion described in these columns some time ago.

Several makers have returned to the use of wire wheels, which, it will be recalled, is the type that was used on the first automobiles. An English wire wheel that has met with success in Great Britain has of late been applied to a number of American cars. Wire wheels are rather more elastic than wood wheels, besides offering the advantage that they can be readily repaired, even when badly damaged.

Rounded or pointed radiators have been adopted by a few more concerns on their 1913 product. They give a car a "speedy" appearance besides being stronger and having more radiating surface.

As regards engines, there were practically no novelties. Two or three firms exhibited cars equipped with the Knight sleeve-valve motor, and a sectional engine was shown in operation. Only one car still uses an air-cooled motor. The vertically flanged cylinders are jacketed and air is drawn down through the flanges by means of fan blades in the flywheel. Another car is fitted with a rotary valve motor such as has been previously described in our columns in connection with aeronautic engines. The 6-cylinder engine, though not quite as prominent as it was last year perhaps, is nevertheless manufactured by most of the leading automobile builders, and can be had at a little higher price than the four. For car prices we refer our readers to the table on page 44 in our recent automobile number of January 11th.

Electric pleasure vehicles were crowded out of the Madison Square Garden show this year completely, and only a few makes were shown at the Grand Central Palace. Noteworthy among these was a brougham which climbed Mt. Wilson in California, a height of over a mile above the sea. This machine is equipped with a lead battery and covers 75 miles on a charge on good roads. In the commercial vehicle shows to be held in the Garden and Palace from the 21st to the 26th inst., doubtless electric automobiles will figure more prominently.

## The Transportation of Live Fish in a Frozen Condition

FISHES belong to the class of animals that have variable body temperature, depending on the temperature of their environment. In extreme cold they assume a rigid condition, in which all of the vital functions are suspended, while life still remains present. During several months of each year some of the great rivers of Siberia are frozen solid to the bottom, but many of the fishes imprisoned in the ice retain their vitality, and resume their active life when the ice melts in spring.

This fact has suggested experiments in the freezing of live fish for transportation, which are discussed in the *Fischerei Zeitung*. Many years ago the celebrated physicist Pictet of Geneva put fresh water fishes into a tub of water, which he kept liquid at the freezing point for 24 hours, and then allowed to freeze slowly into a solid block of ice, which afterward was cooled gradually to —20 deg. Cent. (—4 deg. Fahr.) When the ice was melted, a month or even two months afterward, the fishes began to swim as briskly as they did before freezing, and showed no symptom of ill health.

Similar experiments have recently been made in France. The fishes are placed in water which is kept near the freezing point for a few hours, then at the freezing point for 15 to 18 hours, and finally frozen by immersing the vessel into a freezing mixture, producing a cake of ice a few inches thick, in which the frozen fishes are imbedded. This cake is wrapped in cloth and surrounded with a heat-insulating packing, to prevent melting during transportation. It is necessary to thaw the ice very slowly and to keep the water near the freezing point for several hours, in order to preserve the life of the fishes. Even those which do not survive are in a perfect state of preservation.

## The Death of Dr. Thaddeus S. C. Lowe

AT the ripe age of eighty Dr. Thaddeus S. C. Lowe died on January 16th at Pasadena, Cal. He was a type of brilliant all around inventor and engineer that is fast disappearing. He worked in many fields, usually with conspicuous success. Probably he is best known for his remarkable improvements in water gas apparatus which were adopted generally. So, too, his inventions relating to artificial refrigeration, metallurgical furnaces and coke ovens earned for him fame and fortune. Even aeronautics received his attention; for he was chief balloonist of the Union army during the civil war. Indeed, his early exploits in ballooning were remarkable. He rose to a height of 23,000 feet in 1858 and in 1861 he drifted 900 miles in nine hours. The observatory at Mount Lowe in California was built by him.

## How to Remove Old Wall Paper

A GOOD way to remove old wall paper is to use the following solution: A thick pasty solution should be made by adding flour and a few spoons of salt into boiling water. After this is made add a few ounces of acetic acid, which may be purchased at any drug store. This pasty solution should be applied with a brush to the old wall paper in quantities. After a few minutes the old paper can be removed in great strips very easily and with very little dust or dirt.

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## Attitude of Railroads to the Automatic Stop

To the Editor of the SCIENTIFIC AMERICAN:

Your editorial on "The Automatic Railroad Stop" in the issue of December 28th last, as well as the several articles which you have recently published on automatic train control, have proved of much interest to those concerned in railway operation.

It is a sad commentary on the intelligence of railway managers when a large reward is offered through a displayed paid advertisement, coupled with conditions that savor of an attempt to make the public believe that from a high motive and in the interest of the traveler, the railroad is seeking safety devices which have never been heard of before, as well as to make it appear that to railroad managers such devices are an unknown quantity, and that a reward advertising the road is the only means necessary to encourage the invention of some device to overcome the "human equation."

But the facts remain, that for a long period of years such devices have been exploited, tested, and published, and those interested have been afforded opportunities for investigation, if they desired to do so. It is well known that automatic stops were in service on the Chicago elevated roads before the Boston elevated road was built or even contemplated; automatic stops were used in connection with interlocking and yard signals on the Boston, Revere Beach & Lynn Railroad in 1891; the intramural railway at the Chicago World's Fair in 1893 was equipped with a complete system of automatic block signals and stops, and attracted much attention from railroad managers. In the winter of 1893-4 the Chicago South Side elevated road installed station protection, consisting of signals and automatic stops; and in the winter of 1894-5 the Metropolitan West Side (elevated) road of Chicago installed block signals and automatic stops.

That the subject is not a new one, we refer to the SCIENTIFIC AMERICAN, which nearly twenty-three years ago—to be exact, on May 10th, 1890—on their front page gave illustrations and described a system as follows.

"The Rowell Automatic Railway Safety Stop."

"We had the pleasure of attending a thorough test made of the Rowell safety stop given at Neponsett, Mass., on April 9th.

"A special train of four cars was run from the Old Colony Depot in Boston, and a large number of prominent railroad officials were among the guests. Several tests were made, all of which were successful and conclusively showed that with the safety stop in position, it was possible to stop a train running at the rate of 40 miles an hour in less than 500 feet.

"In the first test the train was stopped in 380 feet; second test was made in 390 feet; and in the third test, made with all the party on board, the train was stopped within 370 feet, and the shock, though plainly felt when the brakes were applied, did not inconvenience anyone. All present pronounced it an unqualified success, and tests were also made with the portable form of safety stop, which enables the conductor to absolutely prevent his train from being run into from either direction.

"Safety Stop.—The effectiveness of this device does not depend upon the speed of the train. It stops the train without the aid or knowledge of the engineer, who can by this absolute protection maintain a high rate of speed on the darkest night, when it is impossible to see the signals.

"B. C. Rowell, the inventor, is an old railroad man, having been for many years brakeman and conductor, and thus has a practical knowledge of exactly what is of use in an emergency.

"This safety stop, while absolute in the protection afforded, is comparatively inexpensive, certain in action, and easily applied. Its general adoption by the roads would greatly lessen the danger of travel and entirely do away with nine tenths of the accidents that are so costly to the companies."

On April 3rd, 1909—nineteen years later—the SCIENTIFIC AMERICAN SUPPLEMENT had an illustrated article on the front page, written by Frank C. Perkins, describing the same invention, further developed, which was installed on the main line of the Chicago, Burlington & Quincy Railroad, and under Government test, as a complete system of automatic train control to meet all operating conditions.

It is not necessary to enumerate the individual tests under the supervision of the Block Signal and Train Control Board during their existence and covered in their printed reports of 1908, 1909, 1910, and 1911, which reports were largely distributed, as many as 6,000 copies of their second annual report (November, 1909) and 5,000 copies of their third annual report (November, 1910) having been distributed from their secretary's office.

The Board was appointed on July 10th, 1907, under a joint resolution of Congress approved June 30th, 1906, "to enable the Interstate Commerce Commission to investigate in regard to the use and necessity for block-signal systems and appliances for the automatic control of railway trains, including experimental tests, at the discretion of the Commission, of such of said signal systems and appliances only as may be furnished in connection with such investigation free of cost to the Government in accordance with the provisions of the joint resolution approved June 30th, 1906." Owing to the large number of devices submitted, the Board informed the inventors that "their ideas cannot be considered unless presented in the form of plans and specifications showing in detail a practicable device designed to perform a useful function, and clearly describing the manner in which that function is proposed to be performed." Only such devices were approved as were considered as possessing merit to warrant the Board in offering to test satisfactory installations.

According to the Board's fourth annual report (December, 1911) the last report issued, a total of 21 automatic train control devices were upon examination considered to possess sufficient merit to warrant the Board to test satisfactory installations. Illustrations of these devices with full description and record of tests under all weather conditions can be found in the Board's reports.

In the fourth annual report the Board states:

"The information obtained from tests, together with knowledge of the general state of development of the art of automatic train control, leads the Board to conclude that there are several types of apparatus and methods of application which, if put into use by the railroads, would quickly develop to a degree of efficiency adequate to meet all reasonable demands. Such devices properly installed and maintained would add materially to safety in the operation of trains. In many situations, under conditions existing in this country, the Board is convinced that the use of automatic train stops is necessary to the safe operation of trains.

"Further, the Board has no hesitancy in saying that had the railroads directed the same effort toward the development of automatic train-control apparatus that has been devoted to the development of interlocking and block-signaling apparatus, we should now have adequate installations of automatic train-control devices which would permit an engineman to handle his train without interference as long as he did it properly, but would intervene to stop his train if he disregarded a stop signal or ran at excessive speed where speed restriction was prescribed."

To ignore these reports because the Board have not designated some one particular device is unjust, as the province of the Board was to report on the good and bad features of each device under test. The Board in their fourth annual report state:

"This Board can do no more than render an opinion concerning the devices examined, and when favorable opinions are rendered, it has only the effect to enable the proprietor of the approved device to advertise more extensively."

The statement that "when favorable opinions are rendered, it has only the effect to enable the proprietor of the approved device to advertise more extensively," is not in conformity with the scientific treatment of an important subject by a body of experts or to be used to cloud their findings. The installations being made at the owner's expense, should not be deprived of a favorable report if the device merited one, as well as all other advantages resulting therefrom.

The railroads have the benefit of five years of Government investigation at the expense of the proprietors; the experimental stage has been passed. There would be no difficulty, if there was a disposition in finding appliances that will meet all conditions of automatic train control. Many of the objections raised are theoretical from lack of practical experience; but in justice to the railroads, and possibly overcoming one of the most serious objections on their part, they should be protected as outlined in the third annual report of the Block Signal and Train Control Board, viz.:

"One objection which has been urged against the introduction of new safety appliances is that after a partial introduction of them, a liability for damages might exist in connection with accidents on part of a railroad not yet equipped with them. It has been suggested that such a situation might be met and the objection entirely overcome, so that no injustice would be done to the railroad, by a simple enactment that the partial application of such devices should not of itself create any legal obligation to equip the entire line in the same manner; that such fact should not be admitted as evidence in any court of an obligation to equip any part of a road not already equipped; and that any case of damage occurring on any portion of a road not equipped should be determined without consideration of the installation on another part of the road."

Protection should be given the railroads when they equip a portion of their road for experimental purposes or by compulsion. Such enactment would undoubtedly remove much of the prejudice now existing, and would tend to promote the development of all kinds of safety appliances.

GEORGE W. RISTINE.

Chicago, Ill.

## Turning Effects of Rudders

To the Editor of the SCIENTIFIC AMERICAN:

My attention was drawn to a correspondence in your issue of July 13th last, by Mr. A. C. Lawrence of Toronto, a copy of which I beg to inclose and which I think much to the point. Why, indeed, should autos be steered from forward, making every turn with a surprising neatness, and a ship twenty times as long as an auto be steered like the wheelbarrow, from behind?

I hereby beg to inclose a set of drawings which, if you compare them with Mr. Lawrence's letter, will express to you my opinion on the matter.

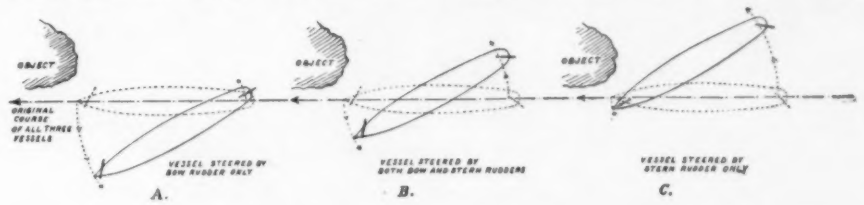
In the drawings of three ships, Fig. *C* corresponds with Mr. Lawrence's explanation of the stern rudder action, and Fig. *A* with his explanation of the bow rudder action. Fig. *B* shows the movement of a ship under the combined control of both bow and stern rudders. I send you, also, the necessary details for a bow or forward rudder such as I have tried, for twelve years, to make the people on this side of the Atlantic to see the use of.

If you, Mr. Editor, would convey a great boon to seafaring men all over the world, publish the inclosed drawings with such editorial remarks as will seem proper to you.

A. H. KIEBL.

Voorburg, near The Hague.

[Our correspondent sends us also sketches of his design for a balanced bow rudder, carried in the forefoot between the stempost and keel and an inner "cage" stempost. The bow rudder is in use on special types of vessels, particularly on ferryboats, the practice being common in American harbors. It would greatly facilitate the quick avoidance of near objects. Structural objections have prevented its adoption on large ocean steamships.—EDITOR.]




## Free Will Versus Determinism

To the Editor of the SCIENTIFIC AMERICAN:

I was glad to see Mr. Agnew's able letter in your issue of December 21st, 1912, supporting man's free will against the shallow, fatalistic theory of the determinists.

No one with any pretensions to enlightenment upholds the latter nowadays. Instead of determinism being the "only thoroughly scientific standpoint," it is merely a relic of the materialistic thought of the 19th century.

Man is not a mechanical automaton, but a spiritual being—a living soul—inhabiting a physical body for temporary purposes; and when he realizes this, and in right of this, he is able to rise above all external forces and limitations.

All of the great thinkers are in favor of free will, under certain restrictions, of course; the greatest of all, Kant for instance, with his "You can because you ought." Capacity goes with obligation. Freedom is the fundamental presupposition of all morality.

Some of the leaders of the materialistic theory have lately acknowledged that behind the laws of nature there must be a Law-giver, thus practically giving their whole case away.

Should any of our readers be still in doubt on the point, let them read Bergson's "Time and Free Will," where the problem is thoroughly thrashed out. Indeed, the controversy is a futile one, arising from a mistaken conception of terms and a lax way of thinking about time and space—a desire to endow duration with the attributes of extensity. As Bergson puts it: "Every demand for explanation in regard to freedom comes back, without our suspecting it, to the following question: Can time be adequately represented by space? To which we answer, Yes, if you are dealing with time flown; No, if you speak of time flowing. Now the free act takes place in time which is flowing, and not in time which has already flown. Freedom is therefore a fact, and among the facts which we observe there is none clearer."

A. K. VENNING.

Los Angeles, Cal.

[The Editor can publish no more letters on this subject.]

The Shuman solar power plant set up at Meadi, near Cairo, Egypt.

# An Egyptian Solar Power Plant

## Putting the Sun to Work

IN the SCIENTIFIC AMERICAN of September 30th, 1911, we described and illustrated the solar power plant which Mr. Frank Shuman of Philadelphia designed for eventual use in Egypt. The plant was actually transported to Egypt, and there set up, but in slightly modified form.

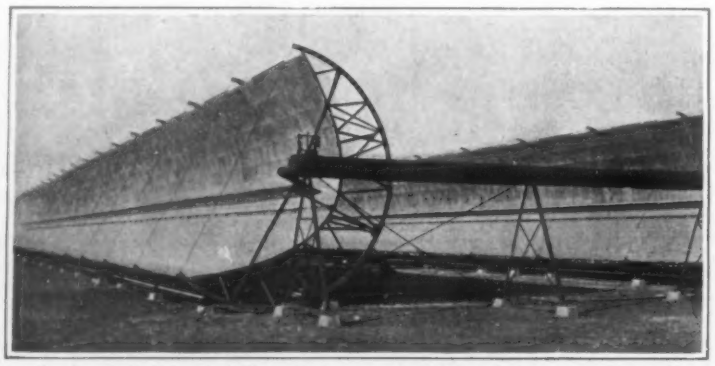
It will be remembered that instead of employing lenses or mirrors, as Ericsson did, to concentrate upon a small boiler the heat rays of the sun, Mr. Shuman utilizes a heat absorber which may be likened to a greenhouse. In the Philadelphia plant a thin film of water flowed over the bottom of a trough inclosed by two layers of glass between which was an airspace. Plane mirrors at each side of the trough reflected additional rays of the sun upon the water. The trough was carefully insulated. In this absorber the water was raised to a temperature very nearly that of the boiling point of water. To utilize the heat energy thus stored up, Mr. Shuman had to devise a special low-pressure reciprocating steam engine. The heated water which is utilized was returned to the absorber after having performed its duty.

In the Egyptian plant Mr. Shuman used parabolic instead of plane mirrors, with better results. All told five absorbers and reflectors were installed at Meadi, a suburb of Cairo. Each reflector, parabolic in form, was 204 feet long, and in its focus was the trough. Silvered glass mirrors lined the sides of the reflector and constantly faced the sun. The troughs of all five reflectors were rectangular in section, 14 inches wide, with sides only three inches apart. In order to increase the heat absorbing efficiency the troughs were painted black.

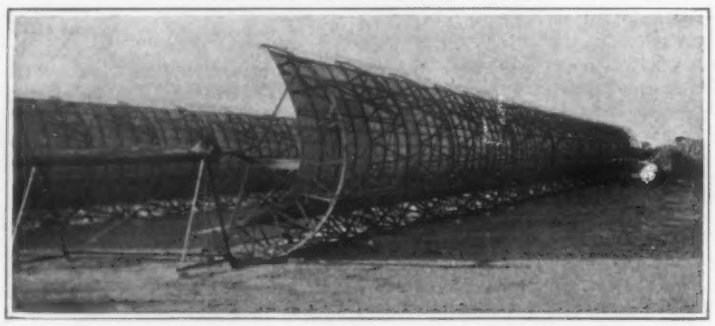
The glass plates and insulating material employed in the absorber of the Philadelphia plant have been discarded. The steam is collected at one end in a pipe four inches in diameter and the water flows in at the other end. Between the water and steam ends there is a drop of six inches in the entire length of 204 feet of the absorber. The engine presumably is the same as that which was used in Philadelphia. It works at somewhat below atmospheric pressure or at a pressure corresponding with a temperature of about 200 deg. Fahr. Connected with the engine is a condenser of the ordinary type and auxiliaries, such as may be found in many a condensing plant. The vacuum to operate the condenser is obtained before starting by means of a gasoline-driven air-pump. After the plant is in full operation the gasoline engine is cut out.

In order that the reflectors may be cleaned—an operation more or less frequently necessary because of the dust prevalent in Egypt—the mirror frames can be tilted and the mirrors washed with a hose.

In the Philadelphia plant the troughs were mounted on supports which elevated them some thirty inches above the ground and which permitted them to be inclined perpendicularly to the sun at the meridian. These adjustments of the installation were made about once in three weeks. In the Egyptian plant the reflectors were made to follow the sun automatically throughout the day by gearing them up with the main steam engine itself. This was accomplished by a pair of friction pulleys controlled by a special regulator, the chief element of which was a thermostat.



In the focus of five parabolic reflectors, each 204 feet long, a trough is placed through which water runs in a thin film.



The mirrors are carried on arc-shaped frames which can be rocked so as to face the sun at all times.

Instead of twenty-six rows of absorbers the number used in the Philadelphia plant, five only were installed in Egypt, so placed that one could not shade the other.

The Egyptian plant was started with zinc boilers or absorbers. A temperature so near the boiling point of zinc was reached that the troughs finally hung down limply like wet rags. Although hard solder was employed, it melted down at the top of the absorbing troughs. For all that, Mr. Shuman assures us, the zinc absorbers lasted long enough to prove that the plant might be eventually successful. He claims to have found that water can be pumped for less than one third of the price which would have to be paid if coal were burned. A set of steel troughs is now in course of construction, which will probably be installed in about four months. By welding the joints with the oxy-acetylene flame he hopes that they will be absolutely indestructible.

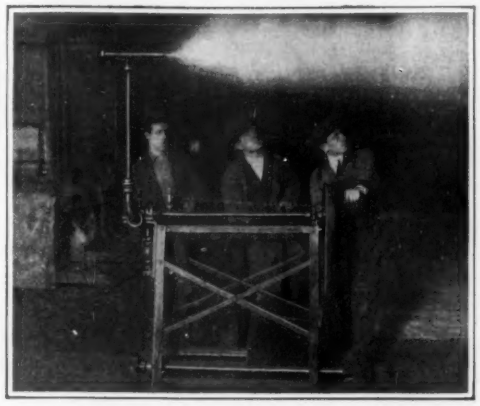
Mr. Shuman states that the steam pipes are so long that the steam becomes highly superheated where it issues near the engine.

Up to date something like one hundred thousand dollars have been spent on these experiments.

### The Art of Primitive Man

OUR far-off ancestors of the stone age, the rude and primitive men of the quaternary epoch to whom the use of fire was unknown and whose arms consisted of a few roughly-hewn pieces of flint, nevertheless appear to have had some rudimentary artistic ideas. In fact, sculptures dating from 200,000 years were shown at the last congress of prehistoric archaeology and anthropology, which recently held its fourteenth meeting at Geneva. This subject was treated by a French scientist, M. Dharvent, of Bethune, and he showed specimens of sculptured silex representing animal figures which were found in the alluvial strata of the quaternary epoch among arms and instruments of the same period. M. Dharvent made an interesting communication to the congress about these first trials at sculpture which have yet been discovered. Natural stones were used which had some resemblance to animal figures, and these were afterward retouched so as to finish the work. One of the striking specimens is the head of a monkey, in which the features are very clearly seen, especially when viewed in profile, as the photographs show. We hope to be able to obtain views of these specimens in the near future. Heads of other animals and birds are also among the most remarkable specimens. Authorities on prehistoric questions consider that the strata bearing these finds date from about 220,000 years.

**A Massive Rudder.**—What is believed to be the largest rudder ever made in two pieces, the top portion weighing 27 tons and the bottom portion 15 tons, has been built for the new Allan liner "Calgarian," now under construction at Glasgow. The total height of the rudder is 26 feet 6 inches and the extreme width is 21 feet.



The exhaust machine and whistle is driven by a motor. One machine is used for the train and one for the automobile.

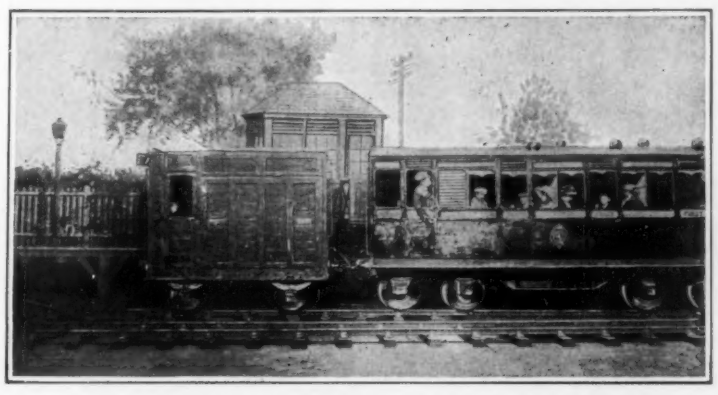
# "The Whip" and Its Mechanism

## A Ponderous Melodrama with Dogs, Horses, Automobiles and Trains that Move and are Wrecked

Back of the car, showing motors for driving false wheels, raising and rotating the panorama. Note the steam exhaust.

"THE DRURY LANE," with its massive melodramas, is a household word among all English-speaking people. The stage of this theater, with its huge electrically-driven bridges, lends itself to effects requiring ponderous machinery and accessories. One of the best plays ever put on at the famous London playhouse was "The Whip," which ran continuously for two years, delighting hundreds of thousands. This production has now been translated bodily to the Manhattan Opera House, New York. There are four acts and thirteen scenes in the play, but we need concern ourselves only with two, which are interesting from a mechanical point of view. These are the famous railroad wreck and the horse race; both of which are now illustrated for the first time by authoritative photographs and drawings.

The entire play is written around "The Whip," a race horse of phenomenal speed, on which large sums of money are wagered. This forms the motive which leads to the perpetration of an atrocious crime. The race is supposed to be run at Newmarket for the "2,000 guineas" stakes. This necessitates the transportation by rail of "The Whip," with her trainer and jockey, in a box car, such as we so often see attached to English local trains. One of the prettiest scenes is that where the race horse is led to the Falconhurst Station and loaded on the waiting box car. Presently you hear the sound of the whistle, the friction of revolving wheels and the exhaust of steam, and a regular English coach, with four compartments, comes slowly down the track and picks up the box car. The signal to start is given, the wheels revolve, the country flashes past. After a few minutes a tunnel is reached, and the audience can even see the bricks as the train rushes through it. This is the opportunity which the villain has been waiting for; the death of the mare must be accomplished at all hazards. He opens the door of his compartment; crawls along the running-board,



The box car containing "The Whip" leaving Falconhurst Station.

throws off the tail light on the box car and uncouples the car, leaving it standing on the track, while the train passes out of view of the passengers.

The heroine finally succeeds in reaching the tunnel by automobile just in time to release the horse and the jockey; the trainer having been detained by a misadventure in Madam Tussaud's "Chamber of Horrors." They make frantic efforts to flag the express, which is heard approaching at a rapid rate of speed. The engineer fails to stop in time and the locomotive strikes the box car, which is converted into kindling wood. There are many passengers on the express train killed and wounded. The steam and fire effect at the locomotive is very realistic.

Now, let us explain how it is accomplished. The coach is operated by about eighteen men, who control the various switches and force the car back and forth, attend to the exhaust, to the whistle, and to the management of the panoramas. Only three men can be shown at the back of the coach, otherwise the machinery would be obscured. There is a set of false wheels in front which do not run on the track, but mask the actual wheels. An electric motor serves to operate them, motion being transmitted from the rear of the coach to the false wheels by the aid of shafts. There is another motor which raises the small panorama at the back of the coach which serves to simulate the bricks in the tunnel. A third motor is for the purpose of driving this panorama widthwise. The electric lights in the coach go out for an instant when the panorama is raised. The effect of the exhaust steam from the locomotive is obtained by using a jet of steam illuminated from a spot-light and working intermittently. A simple exhaust throttle valve controls this jet. It is started by hand, and when the speed of the train is to be increased a motor is thrown in. The whistle is carried on the same framework and is blown at the time of starting and stopping. A simi-

(Concluded on page 102.)

Photos. copyright 1913 by Munn & Co., Inc.

The wreck at Mansfield Junction. The horse is saved, but the box car is destroyed. Dots show path of steam pipes.

## Climbing a Magnetically Supported Chain

By Our Berlin Correspondent

AN interesting experiment was recently made at the works of one of the large German manufacturing firms with one of their lifting magnets. A chain secured to the ground at one end and carrying an iron ball at its free end was raised to a vertical position by the approach of the lifting magnet suspended from a crane.

As seen from the accompanying photograph, the chain throughout its length remained in vertical position below the magnet. A grown-up workman climbed up the chain without disturbing its rigidity. The chain seemed to float in air. The magnetic pull on the ball was greater than the gravitational pull on the man.

This remarkable experiment shows the enormous power of attraction exerted by industrial lifting magnets as used on an ever-increasing scale in iron and steel works for the transport of iron materials of every description. In no other field of metallurgy are the economical advantages of transport by electricity so conspicuous as in connection with the use of lifting magnets, which enable the operator to seize the iron material at any point desired, conveying it to any other point within the range controlled by the crane. Incidentally, it should be noted that the use of lifting magnets eliminates much of the risk of accidents formerly connected with manual transport and the use of hand operated cranes.

Cranes with lifting magnets are of course used on a large scale also in connection with the loading and unloading of railway wagons with all sorts of iron material.

## His Mattress a Life Raft

A RETIRED lieutenant of the U. S. Revenue Cutter Service recently hit upon the idea of making a life raft which may serve also as a mattress for use in bunks and beds on shipboard, as well as in houses and hotels along waterways where floods and overflows may take place suddenly and endanger the lives of the occupants. The mattress is constructed of resilient material provided with the usual ticking and surrounded with a waterproof and substantially airtight casing. This is further provided with an outer waterproof envelope to act as a protecting sheath for the inner casing. In place of felt the inventor prefers to use a resilient filler which is in itself a water-resisting material, so as to prevent the mattress from becoming watersoaked, in case the cover becomes ruptured or torn. In order to prevent the mattress from sagging in the center or bending under the great tortional stresses to which it may be subjected by the waves, a rigid marginal stiffening frame is provided. Lashings are also attached to each corner of the mattress, so that when it is used as a life raft, they may be tied diagonally across the mattress to strengthen the frame and also to provide means for securing persons or articles to the float. In addition to this, loops and handholds are provided along the margin of the mattress. One of our photographs shows the mattress in use as a raft. In order to fairly test its efficiency, a mattress only 24 inches wide and of a size to fit the army transport stateroom bunk was punctured with seventeen holes and then heavily loaded with lead and floated in the water. It remained in the water for thirteen days, without showing any tendency to sink. The accompanying photograph shows the appearance of the mattress after this treatment.

## The Edison Electric Safety Lamp

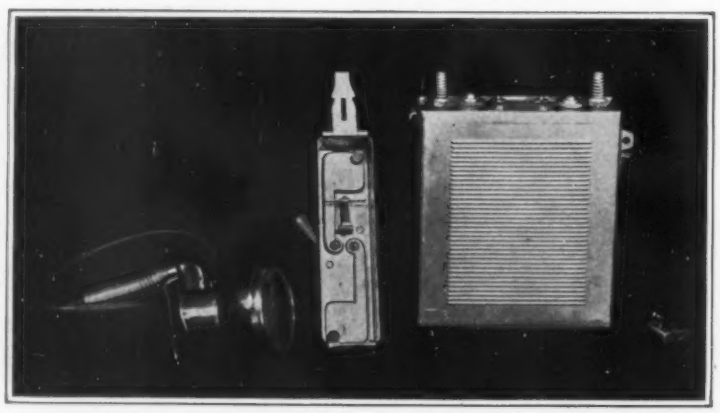
ON the evening of January 23rd, at the American Museum of Safety, New York, the Rathenau Medal granted by the Allgemeine Electricitaets Gesellschaft, Berlin, for the best device or process in the electrical industry for safeguarding industrial life and health will be awarded to Thomas A. Edison, for his safety miner's lamp. The desirability of using electric lamps in place of oil lamps, even those protected with a "Davy" wire screen, is strongly felt in these days. What is needed in mines is a positive light which does not depend upon the uncertain quantity of oxygen contained in the surrounding atmosphere, but is absolutely self-contained. Further, even a Davy lamp is not perfectly safe if through careless handling it is broken.

Mr. Edison's miner's lamp is operated from a storage battery of large capacity and very light weight, which may readily be carried upon the back of the miner in the manner indicated in the accompanying engraving. The nickel oxide battery is particularly adapted for such work where it is liable to be roughly handled, and subjected to such treatment as would put the ordinary lead storage battery out of commission in a short time. The battery is completely sealed and locked so that the miner cannot tamper with it, and it has only one miniature outlet for the escape of harmless gases when it is being charged. There is no danger of escape of the electrolyte even if the cell is inverted, because the outlet for the gas is at one end of the steel tube which extends downward from the top of the container to within a half inch of the top of the electrolyte, and is so formed as to preclude the escape of the solution even when the cell is violently shaken. The gases that pass off do not carry with them any substance to corrode the steel parts used in the construction of the lamp or the case of the battery or the clothing of the miner. No injury is done if the cell is overcharged and no harm comes to the plates if left semi-charged or discharged for an indefinite period. The cell may even be charged backward without serious consequences, although of course the battery will give no service unless charged in the proper direction. The only attention required aside from charging the battery is to replenish it with distilled water from time to time and renew the electrolyte after about nine or ten months of continuous daily service.

The flexible cord connector between the battery and the lamp is provided with a terminal which when shoved into the socket of the battery case becomes locked therein and cannot be removed until the padlock on the side of the case has been removed and the lock-bar withdrawn. And so it is impossible for the miner to cause a spark by disconnecting his wires in the mine. To protect the conductor it is incased in flexible steel armor so as to prevent a sharp bend. A tungsten lamp is used with a parabolic reflector and a heavy lens to distribute the light over the proper area, and the lamp is provided with a hook that may be fitted to the regulation miner's cap. This lamp is the result of several years of persistent work on the part of Thomas A. Edison.

Climbing a magnetically supported chain.

How the electric safety lamp is worn by a miner.



The safety lamp and battery with battery lock bar removed.

Using the mattress as a life raft.

Mattress after floating for 13 days.

## The Life of London

FROM the London County Council's statistical abstract for 1911-12 some conception may be formed of the activities of that portion of Greater London which is confined to the county of London. It should be understood that Greater London, with an approximate population of 7,250,000, overlaps the county of London and passes into the counties of Middlesex, Herts, Essex, Kent and Surrey. Some of the figures given in the London County Council's abstract appear below:

Population, 4,522,961; debt, $558,853,980; weddings a year, 40,201; births, 112,795; deaths, 61,909; deaths by accident, 1,846; fires, 3,208; paupers, 140,560; police, 17,293; soldiers, 10,058; postal employees, 49,969; firemen, 1,365; motor cars, 8,318; postoffices, 1,061; letters delivered, 805,900,000; post-cards, 199,800,000; telegrams, 25,662,000.

The imports into London constitute 33.6 per cent of the total imports into the United Kingdom, and more than half the income tax on salaries is paid by London.

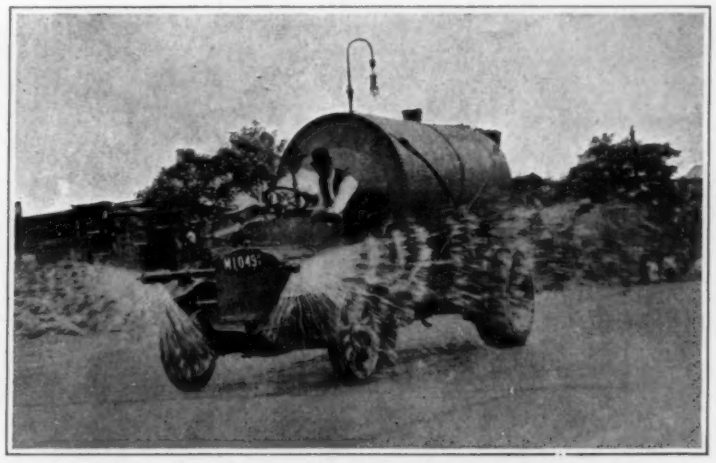
## Motor Street Sprinklers in Europe

REGARDING the use of special power wagon outfits for municipal service, we may mention that the city of Paris is now employing a number of automobile sprinklers and sweepers, these being made by several different firms. It is stated that the city of Berlin is to purchase 16 combined sprinklers and sweepers, representing the sum of $40,000. As to the fire department work, the Berlin department now has 50 auto-pumps in service, and unlike those of Paris most of them are operated by storage battery. The annual upkeep figures as high as $700,000. Munich is following the movement and is experimenting with automobile service. The first of these outfits gave good results, and an entire change will likely be made.

*READERS are invited to contribute to this department photographs of novel and curious objects, unique occurrences, and ingenious contrivances. Such as are available will be paid for promptly.*

### Motor-pumped Street Sprinkler

IN order to provide a wider distribution of water from a street sprinkler a machine has been built which is propelled by a gasoline engine, and which has a double-acting water-pump driven by the motor. With this combination the water may be spread over streets 70 to 80 feet wide on a single run. The operation of the pump may be governed to control the area to be sprinkled and to insure a uniform distribution of water. One of the objections to the usual type of horse-drawn sprinklers is the fact that the nozzles are placed at the rear of the vehicle, and do not prevent the raising of dust by the wheels and horses. In order that the motor truck may not cause the very evil it is designed to cure, the spray nozzles are placed about a foot in advance and on either side of the motor hood. Thus the street is wet down in advance of the wheels and no dust is raised. The sprinkler shown in the engraving has a tank 4½ feet in diameter with a capacity of 1,400 gallons, which is mounted in a cradle and guyed with cross braces upon a 6½-ton chassis. A curious phenomenon may be seen in the illustration. The pulsation of the double action pump may be clearly observed in the spray of water thrown off from the nozzles.



Note the spurting spray caused by the pulsations of the pump.

### A Granite Statue of Electricity

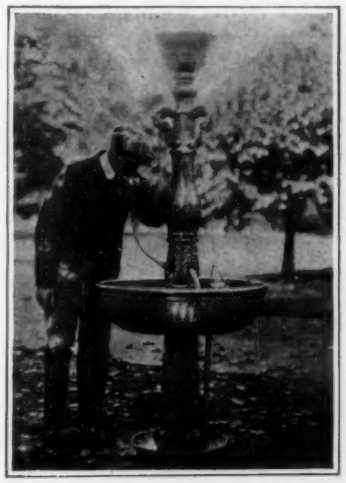
THE Union Station at Washington is ornamented by six large statues ranging at intervals above the main entrance and looking out over the plaza that looks off to the Capitol building only a short distance. One of the statues, representing Electricity, is shown. It is the work of St. Gaudens and presents a majestic figure carved from a solid block of granite. The statues are probably the largest ever cut in a solid piece from granite, and while they appeared colossal when on the ground, as will be appreciated from the comparison with the two men standing alongside in the picture, they are well proportioned to the building when elevated to the high position they now occupy. The hoisting of the statues to a considerable height was no mean engineering proposition, and was accomplished by suitable derricks and hoisting cables. To facilitate the operation the statues were supplied with a composite "corset" of heavy timbers and steel wire to receive the hoisting cables without injuring the carvings of the beautiful figures.

Raising the statue of "Electricity" at the Union Station, Washington.

Legs of Max Unger's gigantic Frithjof monument.

### New Sanitary Drinking Fountain

A NEW type of sanitary drinking fountain has been erected in Lafayette Square, Washington, D. C. This square lies immediately north of the Executive Mansion and almost in the shadow of the Cosmos Club of Scientists and the staid, aristocratic St. John's Church, which most visitors to Washington remember. The design of the fountain is rather ornamental, but unobtrusive. The fountain has a large basin into which the overflow from the "nozzle cups" discharges. The nozzle cups are at the outer ends of flexible tubes whose inner ends connect with the water supply, and the water flows up freely through an opening in the center of a dome-like plate rising almost to the top of the cup, so the user can drink without touching the metallic parts of the cup, out of which the water constantly flows in a cleansing stream. The cups are shackled by individual chains to an upper portion of the foundation, so they cannot fall outside the basin when released by the drinker. Thus the cups when not in use discharge into the basin instead of on the ground surrounding the fountain.

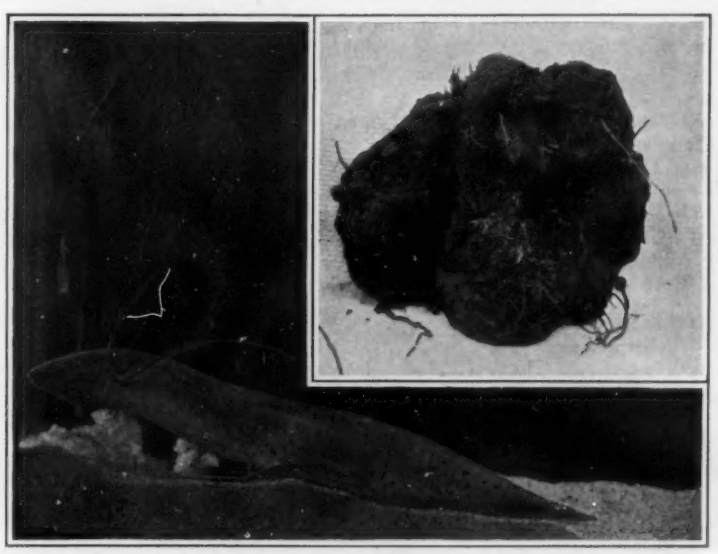


The "nozzle cup" fountain.

"Magnet Bill" saving automobile tires.

### The Curious Lung Fish

A QUEER fish has been received at the Museum of Natural History, New York, that has shattered all popular conceptions of what a fish ought to be, as it possesses the surprising power of living six months, or possibly a year, out of water. Instead of a miniature aquarium or some sort of a box filled with the customary amount of water, for its long sea voyage of thousands of miles, the lung fish was transported in a block of dry earth, which had only a funnel-like opening to admit air for the fish's breathing. This pit led into a tube of hardened slime which went into the fish's mouth and conducted the air directly into the lung of the fish. The "lung fish," as it is called, breathes by means of gills when in water, but with a lung during the summer drought, inhaling and exhaling air as though it were a land-living animal. The fish came from the Gambian region of Africa, coiled up in a kind of cocoon or capsule, deeply sunken in a large clod of earth. To liberate the fish it was necessary to cut the hard earth away carefully from the papery cocoon. Then the cocoon was placed in tepid water to soften the shell, which was formed by a mucous secretion on the surface of the fish's body. Within a few minutes the cocoon showed movements and shortly the fish emerged from it. The lung fish has been placed on exhibition in an aquarium in the Hall of Fossil Fishes. Prof. Bashford Dean states that it had been placed there because it is at home, scientifically speaking, among fishes which lived millions of years ago and whose race is almost extinct. A more complete description of this curious creature may be found in the current SUPPLEMENT.



African "lung fish" and a lump of mud containing the capsule in which it lives, breathing air during a drought.

### A Gigantic Monument

THE German Emperor's passion for monuments expressed in a series of rather inartistic statues which have been mounted in the Siegesallee of Berlin, to the intense amusement and disgust of all the comic weeklies in Germany, is responsible for Max Unger's Frithjof monument. Next summer this colossal piece of work, the mere legs of which are presented in the annexed illustration from *Moderne Kunst*, will be unveiled in Norway to commemorate the twenty-fifth visit of the Emperor to that favored Scandinavian country. Naturally the monument is a gift from the Emperor, and he himself will attend to the unveiling. The imposing legs herewith reproduced attain the majestic height of 23 feet. It goes almost without saying that the monument had to be made in small pieces. The statue will be erected on a peninsula opposite Balholm, where, according to tradition, the graves of Ingeborg and Frithjof are to be found.

### Saving Tires With a Magnet

HE doesn't look like a very important part of a big automobile factory organization, this tall, broad-shouldered, stooped and somewhat grizzled man who may be seen, rain or shine, summer or winter, walking slowly about the plant, eyes almost constantly cast earthward; but he is an important item in the modern method of factory operation. Though his wage is that of the average workman, "Magnet Bill," as the grizzled man is known, is worth a good deal to the company by which he is employed. "Bill" gets his nickname from the fact that his tools consist solely of one tin bucket of the 10 or 12-quart variety and a big steel magnet, strapped to the end of a shovel handle to allow for ease in operation. And his work is very important even though it looks simple to the passerby, for it is "Bill's" duty to save automobile tires by removing from the roadway every nail and bit of iron or piece of steel that might cause a puncture. When it is known that 40,000 cars are run over this course to and from the place where they are tested, and scores of visitors' cars, office machines and delivery trucks use the thoroughfare daily, the value of Magnet Bill is at once apparent.

## The Mercy of Steel and the Menace of Wood

### A Study of Some Recent Railroad Accidents

WHEN the "Titanic" brushed elbows with an iceberg and tore open two hundred feet of her length, the public wondered at the frightful character of the injury. But the engineer did not wonder—he knew perfectly well, although he had temporarily forgotten it, that the one-million foot-tons of energy in that onrushing ship was sufficient, had the obtrusion been solid rock instead of crumbling ice, to have opened up the whole length of the ship, if the pressure of her helm had sufficed to hold her a little longer against the side of the iceberg. In multiplying length and breadth, tonnage and speed, naval architects had overlooked the fact that it was incumbent upon them to introduce under-water constructions, which would limit the dangers due to the enormous energy of the giant vessels of the twentieth century.

What is true of the sea is true also on the land. There has been an astonishing growth in the length, size and weight of the modern railroad train. Cars have tripled and engines have doubled in weight, during the past three or four decades. Speed, also, has gone up to a higher figure, and with all this there has come an enormous increase in the energy, the destructive energy, of the train, when it is developed by collision, derailment or other form of accident. Let us prove this by figures. The modern steel car weighs 70 tons, and the modern express locomotive 200 tons. Such a locomotive on level tracks can haul ten such cars at a speed of seventy miles an hour, and, on a downgrade, 80 miles an hour or more. At 70 miles an hour, a train weighing 900 tons would have a striking energy of 150,000 foot-tons. If, through disobedience or failure to see signals, it dashed at full speed into a stalled train, it would strike a blow equal to that delivered by three of our latest 12-inch naval guns—and each of these, be it remembered, can bore a 12-inch hole clear through some 42 inches of iron.

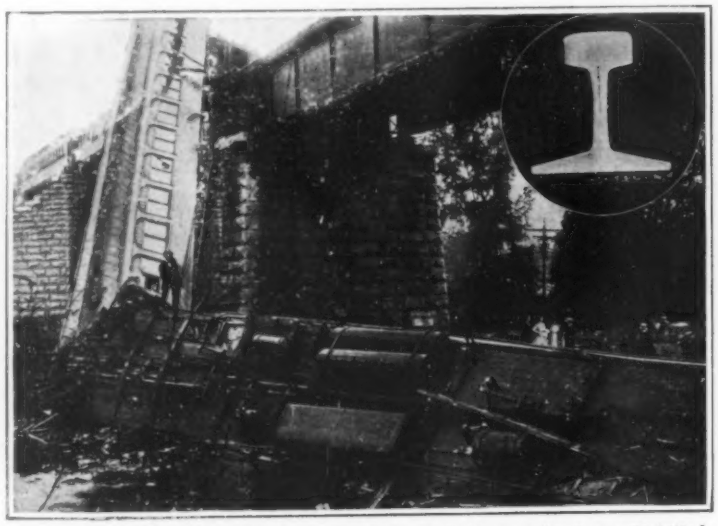
How many enginemen of fast expresses realize that, if they were riding three 12-inch shells, delivered at point-blank range, they would hit the target no harder than the fast-flying train which they hold in their hands would hit a standing train ahead.

Now, when from 50,000 to 150,000 foot-tons of energy is suddenly arrested, whether by the instantaneous shock of collision or by the more gradual and multiplied shocks of a derailment, something has got to go; and just how it goes is shown in the accompanying series of photographic views of more or less notable railroad accidents which have occurred during the past eighteen months. They represent photographs of wrecks which were investigated by Mr. H. W. Belknap, Chief Inspector of Safety Appliances for the Interstate Commerce Commission. Federal inspection of railroad wrecks is a development of the past few years; and one has only to read the many careful and intelligent reports which are regularly issued by the Commission, to understand that this section of their work is one of the most powerful of the many influences which are now working for the promotion of safe railroading.

The writer has selected these views with a view to emphasizing two truths: First, the peril of the faulty steel rail, and second, the merciful protection to life and limb which is afforded by the steel car. The first photograph shows the results of a derailment, caused by a broken rail, which occurred August 25th, 1911, on the Lehigh Valley Railroad, near Manchester, N. Y., and resulted in the death of twenty-nine persons and the injury of sixty-two others. The track was first-class and well maintained, consisting of 90-pound rails, with tie-plates on each tie, the rails being double spiked on the inside of the rail through the plates. The train consisted of two engines and fourteen cars. The rail broke, probably under the engine, at a point 247 feet west of a steel girder bridge over Canandaigua Outlet. Two cars fell over the bridge. The first dropped entirely, and in it the majority of the fatalities occurred. The second car fell and stood on end as shown. The pieces of the broken rail were sent to the Bureau of Standards, Washington, and most carefully examined. It was found that the rail was what was known as a "piped" rail, and the report states that the piping or "slag spilt" could be seen in practically every portion of it. The illustration in the corner of our engraving shows this pipe—represented by the fine black line extending through the vertical web. No inspection of the track could possibly detect a defect so completely concealed.

This accident, then, is chargeable to faulty work at the rail mills.

There is probably no defective member of which the railroad man stands in greater fear than the "piped" rail. It has been the cause of endless wrecks, some of them of the most disastrous character. The "pipe" is, generally, a hollow shrinkage cavity formed when the ingot is cast, which is closed up when the rail is rolled, and exists as an incipient flaw or fracture in



I. A broken rail, due to pipe (corner cut) caused this wreck. Loss: 29 killed, 62 injured.

II. View showing where an express train spre at rail 1, where eleven spikes

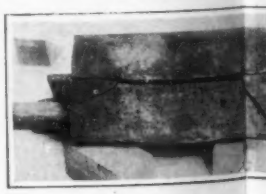
Courtesy of Railway Age Gazette

IV. This train running at 60 miles an hour was derailed at a bridge. Note excellent

Photo. by Henney

V. The two weakest cars (wooden) in this train were telescoped into the space occupied by one car.

VI. Split heads due



VII. Base fracture where break shown in VI. and VII. caused

IX. Between engine and steel car is wreckage of wooden car.

These three illustrations show the relative behavior of steel and wood

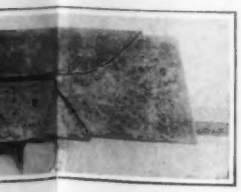
X. Steel car after crushing wooden day coach

press train spread the track. Damage begins eleven spikes were pulled.

III. Wreck due to spreading shown in adjoining cut. Note excellent condition of the steel cars.

te excellent condition of the steel cars. Roof of first steel sleeper smashed by coal car.

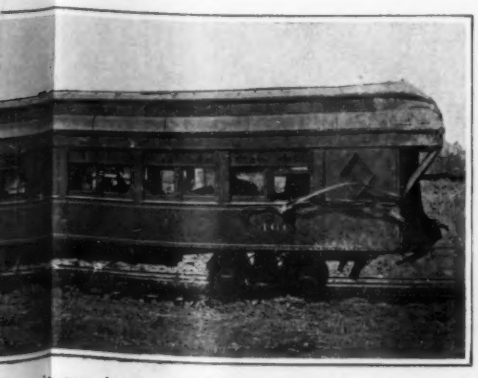
heads due to pipe.



where break began. The rail VII. caused loss of five lives.

Photo. by Henley

VIII. General view of derailment which telescoped the wooden cars shown in opposite illustration.



d wooden cars in the disastrous rear-end collision at Corning, New York.
day coach and two thirds of wooden sleeper.

XI. Steel car and wrecked two thirds of sleeper.

the body of the rail, where it is generally entirely hidden from sight. Under the stress of traffic, cracks develop, spread and ultimately result in complete fracture. Illustrations VI. and VII. show broken sections of a rail, which went to pieces under a train on the Great Northern Railway, near Sharon, N. D., causing the death of five people and injurying eighteen others. The entire train of eight cars was derailed. The head of the rail was found to be split for a length of nearly eight feet; but the investigation showed that the initial rupture at the time of derailment was a crescent-shaped fracture in the base of the rail (shown in illustration No. VII.) due to laminations in the metal. The split head was due to segregation of the phosphorous and sulphur in the rail and irregularity in the carbon contents. These defects are chargeable to the present unsatisfactory methods of rail manufacture. They are curable by the use of such methods of ingot casting as that shown in our issue of December 21st, 1912, describing the Hadfield method of casting ingots.

The 90- and 100-pound steel rail, if properly made, will stand up to its work, even under the exacting conditions of present heavy and fast traffic, provided it is thoroughly fastened to the ties, and ties and roadbeds are maintained in absolutely first-class condition. Illustrations III. and IV. show the derailment at Hyde Park, New York, March 31st, 1912, of the Twentieth Century Limited, while it was running on a 2-degree curve at a speed of 50 to 60 miles an hour. Says the Interstate Commerce Commission Report, "It is believed that the use of shims" (small blocks of wood used to raise the tracks and placed between rails and ties) "together with irregularities or unevenness in the track, so weakened the track structure that it could not withstand the strain due to the heavy locomotive and trains rounding the curve at high speed, and the outside rails were forced outward, probably by the engine."

From the point of derailment the outside rail of the curve was turned completely over for a distance of about 1,700 feet. The first rail to be disturbed is marked 1 in illustration II. On the inside of this rail eleven spikes were partially drawn; and on the inside of rail 3, the outside ties had been crowded outward more than their width. The engine, tender, a buffet car and one sleeping car remained on the roadbed. The remaining five cars, four of them of steel, rolled down the embankment and came to rest on the heavy ice of the Hudson River. This served to show, first the insufficiency of the common form of track fastening to hold the outside rail on curves up to its place against the centrifugal thrust of the modern, heavy, high-speed train. The remedy is to be found in using tie plates beneath the rail on every tie and substituting the powerful screw spike for the archaic and very inefficient wedge spike, which, after all is said and done, is nothing more or less than a magnified nail. The other lesson taught is the wonderful protection afforded by the strong steel car, which, even under such rough handling as this, was neither telescoped nor crushed. The picture of these cars lying intact on their sides, on the ice of the Hudson River speaks for itself.

Further proof of the remarkable strength and stiffness of the steel car was given in the wreck last November of a fast passenger train on the Pennsylvania Railroad at Glen Loch, Pa. This was a heavy fourteen-car train, of steel construction, hauled by two engines. A box-girder on a bridge which the train was crossing yielded under the weight of the two engines, the depression being about 18 inches; and the jar derailed the train. Five of the 75-ton steel sleeping cars were thrown down the embankment, the cars shutting up concertina fashion, and coming to rest in the positions shown in the illustration No. IV. published by courtesy of the *Railway Age Gazette*.

Years ago, when the SCIENTIFIC AMERICAN was advocating steel-car construction, we pointed out that instead of the telescoping which was so frequent and so destructive of life with wooden car construction, the train of steel cars would probably yield at the couplings, the energy of the train being absorbed in folding up, as it were, the train. Now this is exactly what happened at the Glen Loch derailment. The only steel car seriously damaged of those shown in this picture is the one at the right hand, which turned over on its side, its roof colliding with a loaded coal car, and the relatively frail roof structure inevitably crumpling up under the force of the impact. Four people only were killed. Forty-nine were injured by being thrown around the cars.

The fragility of the wooden car and the fact that the work of developing the energy of the train will occur at its weakest point is shown in the illustrations V. and VIII. of a wreck on one of the southern railroads. The derailment was due to poor track conditions. The energy of the after part of the train, which remained on the track, completely telescoped two rather flimsy tourist wooden cars into less than the space formerly occupied by one of them. By far the most significant

(*Concluded on page 102.*)

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

REVERSIBLE VEST.—W. PRESSMAN, 840 Jefferson Ave., Brooklyn, N. Y. The invention relates to a form of reversible vest, and more particularly to that class wherein the different faces present vests of different characters. It is adapted to be worn to present in effect either a single- or double-breasted vest, and any bulky appearance along the fastening line is eliminated and a smooth tailored effect is produced.

SHOE HEEL.—B. ROSENBERG, 963 Kent Ave., Brooklyn, N. Y. This invention provides a cushion section for a shoe heel and a wearing surface therefor rigidly secured thereto; provides a heel with a felt section, leather-covered to harmonize the appearance of the section with the shoe upper and the wearing lifts; and provides means for uniting the felt section and the body of the shoe.

POCKET BOOK AND POWDER PUFF.—A. WIDRICH, 1097 3rd Ave., Manhattan, N. Y., N. Y. The invention is an improvement in pocket books, and comprises an article having a false bottom containing a powder puff, the bottom consisting of separable parts which can be opened to allow the powder puff to be used.

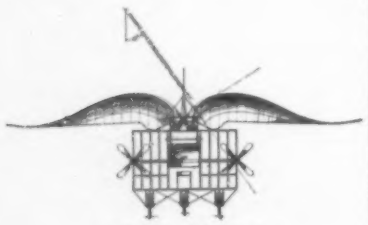
CABINET FOR TROUSERS.—J. FINNELL and J. L. HAMILTON, care of J. L. Hamilton, Red Bluff, Cal. The design in this case is to produce a cabinet to hold trousers in a novel manner to permit of a particular pair being readily removed without interference with the remaining ones. Further, to provide a cabinet that will display the garments to an intending purchaser without removing the articles from the cabinet.

SKIRT AND WAIST RETAINER.—H. GILES, S. Boundbrook, N. J., care of Kops Bros., 16th St. and Irving Place, New York, N. Y. This retainer is adapted to be removably fastened to the front steel of a corset, and an object is to provide a device which may be used to hold a skirt in position and to afford means for holding the shirtwaist tape or band in place close to the band of the skirt, to afford a neat, smooth connection at the waist.

### Pertaining to Aviation.

CONTROL FOR AEROPLANES.—W. A. BARTHOLOMEW, Ravenna, Mich. This improvement relates more particularly to a device for the transverse controlling of the planes, and provides a structure which will act at or near the extremities of the planes, or other convenient points for causing the aeroplane to maintain its proper equilibrium or return to its proper position quickly when moved therefrom.

FLYING MACHINE.—B. QUEZADA, San Jose, Cal., care of W. P. Braggi, 414 San Jose Bank Bldg., San Jose, Cal. This invention comprehends a number of distinct features relating to the wings, the prime mover and its connections with the propellers, a truncated conical body portion, and various other mechanical features for increasing the efficiency. The



FLYING MACHINE.

essence of these improvements lies in the particular curvatures given to different parts of the wings, and the mechanism for conferring these curvatures and maintaining the same. The stability obtained by shaping the wings is almost positive and enables the machine, as a whole, even after power is shut off completely, to descend almost as easily and as gracefully as a parachute. A side elevation of the machine is shown in the engraving.

### Electrical Devices.

TELEPHONE INSTRUMENT.—M. M. REYNOLDS, care of American Tel. Co., 66 Broadway, New York, N. Y. This inventor provides supporting means for the receiver to dispense with the need for holding the receiver in the hand; provides supporting means for the telephone receiver which when moved to service position automatically closes the necessary circuit in the instrument; provides means whereby when use of instrument is discontinued the circuit is automatically cut of; and provides means for at will locking the instrument in position to maintain open the line circuit during intervals of suspension of use.

TELEPHONE ATTACHMENT.—M. M. REYNOLDS, care of American Tel. Co., 66 Broadway, New York, N. Y. This invention relates to an attachment whereby the user will not be put to the inconvenience of holding the receiver while talking, and whereby he may have both hands free to take notes of the telephone conversation if necessary.

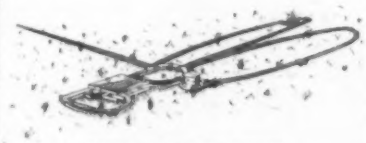
ELECTRICAL MELTING AND SOLDERING APPARATUS.—W. M. BOWLES and C. O. ALLEN, 117 N. Philadelphia St., Shawnee, Okla. An object of this improvement is to provide a heating device for use in melting or soldering metals with great facility and with a minimum expenditure of heat. A further purpose is to provide a portable device which can be readily connected to an electric circuit.

RHEOSTAT.—W. M. BOWLES and C. O. ALLEN, 117 N. Philadelphia St., Shawnee, Okla. An object here is to provide a variable resistance for controlling an electric current in which the resistance members consist of a series of carbon disks. A further object of the invention is to provide means for varying the contact between these disks and thereby throwing into the circuit more or less resistance.

### Of Interest to Farmers.

FARM GATE.—A. M. DOYLE, Leoti, Kan. This invention has reference to operating devices for gates, such as are used specially in rural places, and where it is desirable to avoid the inconvenience and frequent danger to a person traveling alone from dismounting from his horse or vehicle to open the gate.

CATTLE STAKING DEVICE.—R. L. LEE, care of Blue Ridge Hosiery Mill, Landrum, S. C. This invention has reference more particularly to a device comprising a manipulating member; a chain or other flexible element secured at one end to the manipulating member and serving for the fastening or staking out of an animal and means associated with the manipulating member whereby the flexible member can be taken up and shortened. Be-

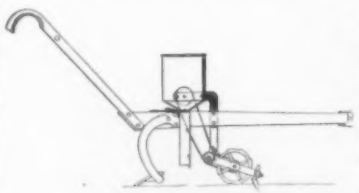


CATTLE STAKING DEVICE.

sides for use in staking cattle or other animals for grazing it can be employed in driving cattle, or in fastening or tying them under different conditions, with means for carrying the chain or other flexible tying member so that the latter cannot become entangled or endanger the animal, or the driver. The flexible member can be lengthened or shortened within the limits of its length, which can be very easily manipulated. The engraving gives a view showing the device in use for staking out an animal.

MILK PAIL AND COVER.—A. F. SCHNEIDER, 506 W. Jersey St., Elizabeth, N. J. This inventor provides a structure adapted to substantially prevent the ordinary mixing of dirt and foreign matter with the milk; and provides for automatically straining the milk at the time of milking, before the milk reaches the receptacle into which it is being milked.

MATERIAL DISTRIBUTER.—J. W. GUNTER and J. A. HAARDT, 112 Highland Ave., Montgomery, Ala. The invention has for its object the provision of an inexpensive machine, wherein means is provided for insuring a regular and uniform feed of the material, operated directly by the movement of the machine, and



MATERIAL DISTRIBUTER.

wherein the feed may be regulated to suit conditions. In operation a cut-off is set to feed the requisite amount of fertilizer, and is held in this position. The machine is drawn over the ground, the wheel in front rotating the shaft and causing the fertilizer to be fed through the chute. The plow opens a furrow to receive the fertilizer and a plate covers the fertilizer in the furrow. The accompanying illustration shows a side view of the distributer.

DRILL SHOE.—F. KERIAN, care of Tobias D. Casey, Dickinson, N. D. The purpose here is to provide a shoe having an elongated body with its rear flared at the bottom, and a seed spout secured to the body with its bottom bent for directing the seed under the flared portion of the shoe. The seed spout is open at its rear end and closed at its front end, to prevent its being clogged with dirt.

WEED CUTTER.—J. F. SCHUBLE, Cashmere, Wash. This implement clears the ground of weeds of the type which is designed to be pulled by a draft animal when in operation; and it comprises a frame carrying means for cutting weeds and other objectionable vegetable growths and supported upon a plurality of adjustable guides which enable the frame to move over the ground at any height therefrom.

PEANUT THRESHING DEVICE.—C. R. LIVERMON, Roxobel, N. C. An object in this invention is the provision of a means for separating the peanuts from the vines and for delivering the peanuts cleared from chaff and dirt from one part of the machine and for discharging the vines from another part of the device.

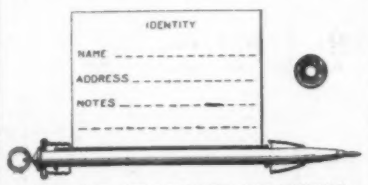
### Of General Interest.

FIRE ESCAPE.—M. FINK, 15 W. 115th St., Manhattan, N. Y., N. Y. This escape permits a person to safely lower another or a number of persons successively from a burning building to the ground, and allows persons to lower themselves, and without danger of injury by falling or by striking the ground

FIRE ESCAPE.

on being lowered, or in case the person should lose his grip. Use is made of a rope for attachment at the upper end to a fixed holder, located at or adjacent to a window or other opening, and a supporting harness permanently secured to the lower end of the rope and adapted to be attached to the person intending to escape. The illustration shows a perspective view of the fire escape as applied.

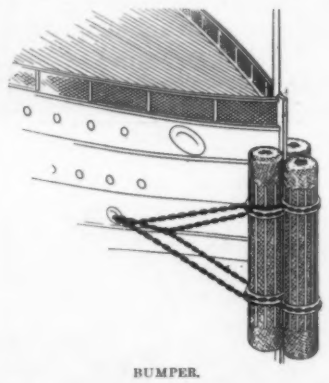
CARD CASE ATTACHMENT FOR PENCILS.—A. B. SCOTT, Fairmount, W. Va. This invention more especially relates to pencil attachments for holding an identification card or the like, and objects of the improvement are to provide an attachment that may be applied to an ordinary pencil and hold the




CARD CASE ATTACHMENT FOR PENCILS.

card rolled into small compass and concealed entirely within the case; to provide for the control and manipulation of the pencil to project and withdraw the lead by operations independently of the case and holder, and to provide holder of neat and compact construction. The engraving shows the body of the card case removed, and the end member or cap of the case in section, the card being shown unrolled.

BUMPER.—F. PÉLISSIER, care of Brevoort House, 5th Ave. and 8th St., New York, N. Y. This invention refers generally to bumpers, and more particularly to an article especially adapted for use on the bow of a vessel or boat, whereby the liability of damage to a vessel or boat in the event of collision is mate-



BUMPER.

rially reduced. The bumper is of a resilient construction and is provided with means whereby it may be efficiently held in position on the ship. A perspective view is shown in the engraving of the bumpers in position at the bow of a vessel.

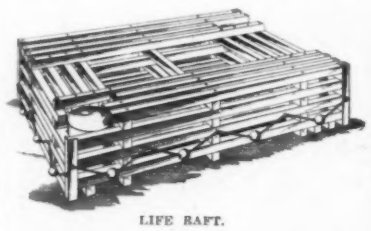
SAMPLE CARD.—B. F. STENZ, care of Simplex Litho. Co., 644 1st Ave., Manhattan, N. Y., N. Y. It is customary in displaying textile fabrics to cut up material into pieces and card or "mount" them, and this entails large expense, not only for sample materials, but for the labor of cutting and attaching material to the cards, and it is with the object of producing a sample card which shall accurately display samples of textile fabrics without the necessity of employing samples actually cut from goods that this invention was produced.

CONTRACTIBLE UMBRELLA.—S. M. SARGENT, 1444 Park Place, Wichita, Kan. In this umbrella the canopy together with the staff, is adapted to be shortened and inserted in the handle as when the umbrella is not in use. For this purpose the handle is expansible so as to open out when the canopy and staff are passed within it, and assume a conventional size when used as ordinary.

SUPPORT FOR CONCRETE REINFORCEMENTS.—C. A. KOERNER, 511 Walker Bldg., 5th and Market Sts., Louisville, Ky. This invention has reference to supports for the steel or other reinforcements for concrete, and has for its purpose the provision of a structure which will correctly support the reinforcing members without defacing the finished work.

ACETYLENE-OXYGEN WELDING TORCH.—J. D. FREAR, care of Fred. H. Buchanan, Centerville, Kan. This inventor provides a simple and inexpensive device for receiving and mixing the gases, wherein means is provided for thoroughly mixing the said gases as they pass to the outlet and without delaying their passage.

LIFE RAFT.—B. E. MATSON, Boston, Mass. This raft is intended to be carried by marine vessels, and the device is formed of a plurality of buoyant members, and airtight and food tanks crated in the buoyant members, all forming the raft. The raft with parts of the



LIFE RAFT.

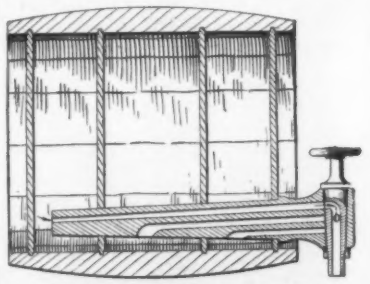
frame or crate cut away and showing the food tank is pictured in the accompanying engraving. It is safe, simple and rigid in construction, and equally efficient when being launched either side up. The buoyant members inclose a plurality of air and food compartments evenly spaced and crated by the buoyant members, and guaranteed from injury by the said members.

COMBINED CIGARETTE BOX AND MATCH HOLDER.—H. A. GRIFFIN, Drawer S., Rocky Mount, N. C. The match holder and igniter is pasted on the front of the cigarette-box proper and is so constructed as to normally cover and protect the fulminate ends of the matches, but serves to ignite a match when being withdrawn.

ICE MAKING APPARATUS.—S. R. BELL, 498 Walnut St., Beaumont, Tex. The intention here is to provide an apparatus having combined means for making the ice and for cooling the brine which is used in the ice-making process, thereby dispensing with additional apparatus for cooling the brine.

LIFE BOAT.—P. E. BÜTOW, 1118 8th Ave., Brooklyn, N. Y. An object here is to provide an open top power boat, which cannot fill by the breaking of the seas over the same, and which is so constructed as to obtain the maximum bearing surface upon the water, and which has its center of gravity relatively low.

DEVICE FOR HOLDING AND DISPENSING BEVERAGES.—J. VERGANO, care of E. D. BERNADI, Santa Rosa, Cal. The aim of this inventor is to provide a barrel, tank or other receptacle or container, with a plurality of separate compartments adapted to contain liquids of different characteristics, together with a single dispensing faucet having com-



DEVICE FOR HOLDING AND DISPENSING BEVERAGES.

munication with each of said receptacle or container compartments, and so constructed that a liquid from any one or the compartments may be dispensed without danger of admixture with the liquid of any other compartment. The illustration shows a central longitudinal section through the devices constituting this invention.

PORTABLE HORSE FEEDING TROUGH.—F. L. MEYER, care of G. B. Uthman, 837 Harrison Ave., Scranton, Pa. This invention provides a supporting frame for a trough, adapted for convenient adjustment upon the colla:

of the harness; and provides a frame having means incorporated therein for adjustment to suit service conditions of the trough when used by horses of various builds.

VAPORIZER.—G. A. EVANS, 909 Bedford Ave., Brooklyn, N. Y. This vaporizer is used for giving off, or in a certain sense exhaling particles of medicinal substances through air passed thereover so that the medicinally charged air may be used for the treatment of diseases of the lungs and the air passages.

COMBINED CUFF BUTTON AND CUTTER.—L. KALINA, care of Midget Mfg. Co., 175 Center St., New York, N. Y. The intention in this case is to provide a new and improved combined cuff button and cutter designed to be worn as a cuff button and adapted to be used as a cutter for use in cutting finger nails, cigars and the like.

FOUNDATION.—E. FRANKIGNOUL, 196 Rue Gretry, Liege, Belgium. This invention relates to the making of foundations of buildings and structures in a manner to enable the verticality or horizontality of the buildings to be quickly and easily restored, should they be interfered with by movements of the ground due, for example, to mining operations.

PROCESS FOR TREATING RAW POTATOES IN ORDER TO OBTAIN BOTH A CATTLE FOOD AND A PROTEID.—H. GUMPEL, Schlagenthin, near Damsdorf-Müncheberg, Germany. The process is effected by separating the juices from the potatoes after they have undergone a suitable preliminary treatment and to use these juices for the manufacture of the proteid substances, while the solid residue is used for the manufacture of the durable animal food.

BOOT CLEANER.—A. M. FAIRFIELD, St. Marys, Kan. The cleaning devices are placed on the floor, and conveniently supported to permit the user to place his foot against the scraper and bushing members. The object is to provide a cleaner, to the end that the shoe may be quickly and efficiently cleaned by the brushing elements of the cleaner.

MUSIC HOLDER.—E. J. BABBITT, Onaway, Mich. This invention relates more particularly to holders adapted for use on pianos and like instruments, and provides a construction light in weight, readily portable, which may be quickly and easily set up in operative engagement with the piano or other instrument and detached therefrom.

CARD INDEX.—L. C. REYNOLDS, 712 Quincy St. N. W., Washington, D. C. This improvement is in indexes in which a series of cards having names or matter printed thereon, in alphabetical order, are held detachably in a frame one above another, so that the matter is always visible on the faces of the cards, each of which is provided with some form of device adapted to engage and support the one above it.

FLUID ACTUATED GONG.—G. R. W. ROBERTS, 2246 San Antonio Ave., Alameda, Cal. This invention relates to gongs for street railway cars, or any other vehicle which has an air brake system or is capable of carrying fluid under pressure. It provides means whereby to continuously sound a gong without effort on the part of the operator subsequent to the opening of a valve for the purpose of starting the actuation.

FEED REGULATOR FOR GRAVITY CONCRETE MIXERS.—G. W. MILLS and J. E. SIMPSON, Georgetown, Pa. The invention provides a device wherein the different materials forming the concrete are mixed in the proper quantities, during their passage by gravity through the device, and wherein means is provided for insuring the proper distribution of the materials before the mixing operations begins.

### Hardware and Tools.

WRENCH.—C. G. YOUNGQUIST and C. F. YOUNGQUIST, 526 Henry Bldg., Portland, Ore. This invention provides a wrench with jaw members which are movable relatively to their supporting heads to assist in obtaining a firm hold on a pipe, resilient means being provided for holding the jaw members yieldingly in position relatively to the supporting heads.

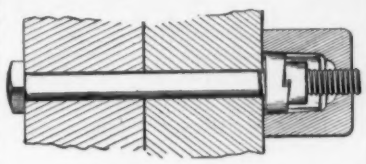
FAUCET CONNECTION.—P. F. ZIETLOW, care of Dr. E. M. DeCastro, 895 Union St., Brooklyn, N. Y. The invention pertains to connections for water spigots, particularly to those for connection with shower bath or bath spray apparatus. A hose connection or the like is made to spigots or reducers of various sizes, without the necessity of making any substitution or alteration in the connection.

SAW GAGE.—G. FRITZ, Park Falls, Wis. The invention shown in a side view in the illustration is a structure which automatically indicates the bend or curvature of a saw applied thereto. The gage indicates on a scale the amount of curvature, the action of the

SAW GAGE.

gage being automatic upon placing the gage tightly against the saw or other surface being gaged. A support having a centrally movable member is resiliently held in an outer position. Connected to this member is a pivotally mounted arm which moves over a graduated scale whereby when the support is placed upon a surface the motion is transmitted to the pointer for indicating the degree of curvature of the surface to which the gage has been applied.

NUT LOCK.—C. J. IVERS, Rushmore, Minn. This invention has for its object the provision of a nut which may be screwed upon a bolt, but which, when once adjusted, is prevented from becoming unloosened, and which will, in fact, have to be cut off if it is ever removed. A further object is to provide a simple and inexpensive form of device for absolutely pre-



NUT LOCK.

venting the removal of the nut by unscrewing it when it is once in position. The device is designed for use on structures in which the permanent position of the nut is desired, and is shown in the accompanying illustration in a section through the nut after it has been applied.

FLUE EXPANDER.—J. B. ANDERSON, Clipper, Wash. In this case the invention has reference to improvements in flue expanders, and it has for an object the provision of an improved structure in which a screw construction is provided for feeding the device forward during the expanding of the tube.

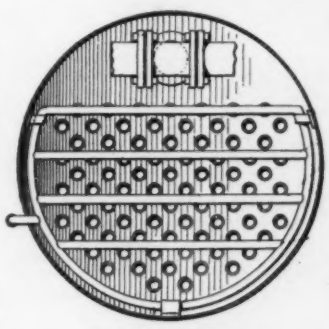
SCREW DRIVER.—G. B. MULLEN, 18th St. and 7th St., Whitestone, New York, N. Y. This invention relates to screw drivers for inserting and withdrawing wood or other screws, and has reference more particularly to one having a shank, a blade at the end thereof and adapted for engagement with a screw head, and a clamp associated with the driver and adapted to hold the screw in position relative to the blade.

KNIFE.—J. A. HARRISS, 141 Riverside Drive, New York, N. Y. The object here is to provide a knife having a detachable blade, which is held against the handle by a hook rod, the hook on the rod engaging the blade around an orifice, and the rod being secured in a channel in the handle. The blade is reinforced by a bar, the butt end of which is disposed in a socket handle.

### Heating and Lighting.

FIREPLACE.—G. L. PERRINE, Sanford House, Excelsior Springs, Mo. Mr. Perrine's invention is an improvement in that class of fireplaces in which the side walls converge to the rear and a horizontal ledge or step extends between such walls. Practical use of the invention has demonstrated that in this fireplace a maximum calorific effect is produced with a minimum of fuel.

SMOKE CONSUMER.—R. H. SHERRY, 2334 Tower Grove Ave., St. Louis, Mo. The invention relates to smoke consumers, and it has for its object to provide a flue boiler with pipes with openings at the front of the boiler, through which air may be carried to mix with the heated gases coming from the flues at the front of the boiler to complete the combustion.



SMOKE CONSUMER.

Various applications of the invention may be used, since the invention includes all constructions in which air is admitted between the fire chamber and the smoke-stack, whether flue boilers are used and whether the boilers are stationary or of other types. The engraving represents a sectional view of the boiler, to which the smoke consumer is applied.

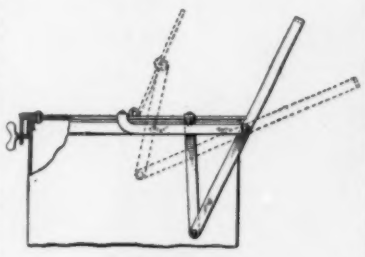
ACETYLENE GAS GENERATOR.—J. F. WILLIAMS, 41 Warren St., New York, N. Y. The object here is to indicate at all times the amount of carbid in the feed hopper and to sound an alarm whenever the carbid in the hopper reaches a low stage, and whereby a supplementary charge of carbid within the hopper may be added to permit of running the acetylene gas generator another length of time, say overnight, before being required to recharge.

CAST IRON BLAST HEATER.—K. MEIER, 12 Fachlisbrunmer, Winterthur, Switzerland. This heater is arranged to provide a large heating capacity for the air in a comparatively small space, to permit increased velocity of the air and to minimize the resistance to the flow of air and reduce the power required for forcing or drawing the air through the steam, hot water or other heater, and to avoid dead air spaces and thereby make the heater self-cleaning.

BOILER.—W. JOHNSON, University Place, Neb. The invention has for its purpose the provision of a boiler suitable for providing steam for motors, or for heating systems, having a special form of heating means, arranged to give the largest possible amount of steam per heat unit.

HOT WATER HEATER AND STERILIZER.—C. J. MADONNA, 443 7th Ave., Brooklyn, N. Y. The intention here is to provide a hot water heater and sterilizer, more especially designed for use in barber shops, hospitals and other places and arranged to furnish a supply of hot water for shaving, and washing purposes, and at the same time permit the sterilizing of a large quantity of towels, napkins and the like.

ASH CAN COVER.—E. M. CORYELL, 410 Richmond Ave., South Orange, N. J. This inventor provides a cover separable from the can which may be opened by laying the shovel with the ashes thereon on a projecting bracket, the weight of which shovel and contents will automatically open the cover to permit the quick insertion of the ashes into the can, the withdrawal of said shovel automatically closing the cover. The cover is of two parts hinged together, one adapted to be removably



ASH CAN COVER.

fastened to the can and carrying a support projecting forwardly of the other part, which support forms a fulcrum for the lever. One end of said lever is attached to said other part, and the opposite end of the lever projects forwardly of the can, as a rest for the shovel. A side elevation of the invention attached to a can, parts being broken away to show the attachment, and the lid and its attached parts shown in raised position in dotted lines, is illustrated herewith.

### Household Utilities.

FLUSHING DEVICE.—A. WILLIMAN, care of N. C. Abbott, 710 1st Nat'l Bank Bldg., Houston Heights, Texas. In the present patent the invention has reference to a flushing device that will operate to flush a closet, or other apparatus, without the use of a separate water tank and obviate the attendant disadvantages of a water tank.

BROOM HOLDER.—W. J. HOPE, Tunica, Miss. Means is here provided for connecting a broom to a handle, in such manner that a considerable degree of resiliency is permitted between the broom and the handle, and wherein the clamping means may be adjusted for brooms of various sizes, and wherein the handle may take a position at an angle with respect to the body, and wherein a positive gripping means is provided in connection with the clamping means.

WEATHER STRIP.—G. L. GODFREY, 1530 Bryant Ave., New York, N. Y. This invention provides a metallic strip to close an aperture irregular in form and varying in width; and provides a rigid metal casing, a movable stop member mounted therein, and means carried in said casing for compelling the sections of said stop member to conform with the contour of the opening to which the strip is applied.

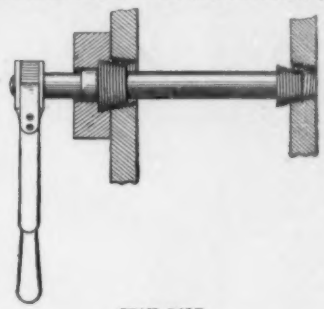
COMBINED MOP HOLDER AND WRINGER.—J. W. KRUEGER, Darwin, Minn. This invention provides a mop having a construction adapting it for combination with a scrubbing device; improves the elements entering into the operation and supporting means of the mop head device; and provides a scrubbing device having means for holding a scrubbing brush adapted for co-operation with the novel mop heads and their appurtenances.

CHILD'S PORTABLE HIGH CHAIR.—F. GREENE, R. F. D., No. 3, Alva, Okla. This invention is an improvement in legless high-chairs, in which the seat and back are hinged and adapted to fold together, and provided with a hook-like attachments adapted for supporting the chair-proper on the back of an ordinary chair, or on hooks or other devices secured to a wall or other rigid support.

SINK FRAME BRACKET.—W. J. DALY, 314 N. Main St., Mason City, Iowa. The bracket is simple and inexpensive, and may be of any desired size and weight. The parts may be made in stock sizes and adjusted to a wide variety of dimensions. The sink is held firmly and without any possibility of accidental dislodgement, yet is easily removable for cleaning or repairs.

### Machines and Mechanical Devices.

STAY BOLT AND MEANS FOR SCREWING THE SAME IN PLACE.—W. L. DECKER, per Calicia No. 9, Mollendo, Peru. The invention relates to boilers, and its purpose is to provide a new and improved stay bolt and means for screwing the same in position with a view to rigidly connect the inner and outer walls from bulging under pressure and to per-

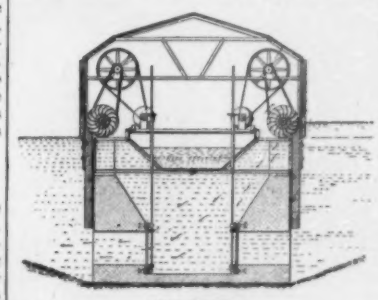


STAY BOLT.

mit of conveniently and quickly screwing the stay bolt in place or removing the same when necessary. The engraving herewith shows a side elevation of the stay bolt partly in position on the inner and outer walls of the boiler, the boiler walls and guide nut being represented in section.

CONCRETE MOLD.—W. H. ALEXANDER, Box 175 Long Branch, N. J. The object here is to provide a mold having a bottom member which may be conveniently rotated and lowered so that a detachable end member will rest on the ground, the mold being provided with side members which have clamps for engaging the detachable end member, and means by which the side members are moved laterally relatively to the bottom member.

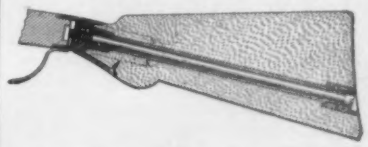
TIDE-MOTOR.—F. D. TAYLOR, 911 Pontiac Ave., Providence, R. I. This invention relates to hydraulic motors and particularly to power devices adapted to utilize the force of both the ebb and flow of the tide. The motor comprises a fixed abutment constructed at any convenient place, such for instance as at the mouth of a bay, inlet, or river, of a height preferably slightly below the water line at low tide and



TIDE-MOTOR.

of a length depending upon the location and amount of power to be developed, the abutment having a series of passageways therethrough, gates adapted to control the water passing through, a float in connection with the abutment, shafts for operating the gates and means carried at a uniform elevation of the float for operating the gate controlling shafts during changes in the elevation of the float. The illustration shows a vertical transverse section of the invention.

ADJUSTABLE STOCK FOR FIREARMS.—O. E. OLIVER, Mount Eden, Alameda Co., Cal. Mr. Oliver's invention is an improvement in that class of gunstocks in which the butt section or stock is pivoted to the front section or grip, so that the two may be adjusted at differ-



ADJUSTABLE STOCK FOR FIREARMS.

ent angles to each other. By the construction and combination of the various parts a joint is formed distinguished by simplicity, lightness, strength, and rigidity. The butt section is adjusted up or down to suit a long- or short-necked gunner or sportsman, or it can be adjusted sidewise to the right or left to suit a wide or narrow-shouldered man or a right- or left-handed gunner as the case may be. The accompanying engraving shows a longitudinal vertical section through the pivoted adjustable stop.

FARE RECEPTACLE.—G. C. STEWART, 2604 W. Main St., Louisville, Ky. This improvement is in receptacles in which are deposited the fares of passengers of pay-as-you-enter cars and other vehicles used for public transportation. All coins taken from passengers and deposited in the mouth of the receptacle must drop into the box before the base of the receptacle can be opened and the box removed; and, hence, the danger of loss to a

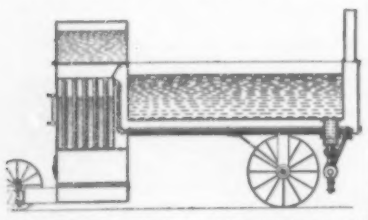
company through thieving is reduced to the lowest minimum.

THREAD CUTTING ATTACHMENT FOR SEWING MACHINES.—ROBERT L. COLEY, care of James W. Cannon, Concord, N. C. The object in this case is to provide a simple attachment capable of attachment to any form of machine with but little change, and for automatically cutting the thread between articles without stopping the machine and without injuring the article.

VALVE GEAR.—E. L. ROBERTSON, 229 Mulberry St., Greenville, S. C. The present invention has reference to valve gears in which the valve rod receives its motion from the usual link mechanism and return crank, through the medium of a lap and lead lever having a link and hanger connection with the cross-head of the piston-rod.

MOTOR STARTER.—A. J. CHARLTON, Lowden, Iowa. This improvement is in motor starters in which a spiral member co-acts with another, one being rotatable, so that by sliding or rectilinear adjustment of one of the members, the other one is rotated, with the effect of imparting rotation to the motor shaft.

MACHINE FOR HEATING AND DISTRIBUTING MATERIALS.—J. F. DECKER, 7 Third Ave., Albany, N. Y. This invention has reference to machines for use in heating and distributing materials, and it has for its object to provide such a machine which may be used



MACHINE FOR HEATING AND DISTRIBUTING MATERIALS.

to heat crude oils, asphalt, etc., and to distribute them on roads. The machine is provided with a water boiler and a tank for the materials, which are heated, steam from the boiler being supplied in jets to the nozzles which distribute the material on the road. A longitudinal, sectional elevation of the invention is represented in the illustration.

MEANS FOR CASTING FINGER RINGS.—F. H. CURL, 2116 E. 4th St., Longbeach, Cal. The invention relates to molding operations similar to the means set forth in a previous patent granted to Mr. Curl. The primary object is to improve the means for casting finger rings or similar symmetrical articles, whereby the operation may be performed much more rapidly and cheaply and with less mechanism or fewer parts than was necessary in the previous operation.

MACHINE FOR CAPPING AND DOUBLE-SEAMING CANS.—H. L. GUENTHER, 278 N. Ave., 23, Los Angeles, Cal. This inventor provides a machine for capping and double-seaming cans, arranged to restore the mouths of can bodies which have become distorted while being filled or handled, to press the fruits or other food products, that may extend above the edge of the can body, downward into the same, to place the can heads in position in the can bodies and to double-seam flanges of the can bodies and heads, and to compress the seams to render the same airtight without the use of solder, and to remove the finished cans from the machine.

WINDMILL.—W. T. SANTALA, P. O. Box 353, Georgetown, Conn. The object here is to provide a mill arranged to hold the windmill at all times in the wind, and to permit of exposing more or less of the wheel to the action of the wind, according to the power thereof, thus insuring a proper running of the windwheel in light or heavy wind.

CLOSING DEVICE FOR DYEING VATS.—C. P. DELAHUNTY, care of Delahunty Dyeing Machine Co., W. Pittston, Pa. An object of the present invention is to provide a readily manipulated cover, which may be actuated manually irrespective of its weight, and is especially adapted for large sized tanks where some mechanical arrangement must be utilized in order to entirely uncover the vat, so that the opening is entirely unobstructed when filling the vat.

ABRASIVE BELT MACHINE.—C. H. DRUEY, care of John C. Stephan, Midland Furniture Co., Evansville, Ind. This invention has reference to abrading or polishing machines and has particular reference to devices of this character adapted for a wider range of adjustment and field of operation than other machines previously proposed.

DEVICE FOR EXHIBITING PICTURES.—A. S. WARREN, 20 Prospect St., Batavia, N. Y. This device involves reels or spools for receiving a strip bearing pictures that may be brought into view successively, and it is a design to provide a device wherein a plurality of supporting and guiding devices are so arranged that a strip bearing pictures on opposite faces thereof may be so moved as to exhibit the pictures on either side of the strip or film.

DITCHING MACHINE.—A. E. HANSON, Mason City, Iowa. The object of the present invention is the provision of a new and improved ditching machine arranged to readily form the ditch to any desired depth, and to divide the material and deliver the same to opposite sides of the ditch in a very simple and economical manner.

MACHINE FOR USE IN THE MANUFACTURE OF INCANDESCENT GAS MANTLES.—J. I. ROBIN, 54 Cheapside, London, England. This invention has reference to the manufacture of incandescent gas mantles, and while it is particularly applicable to mantles of the kind which are composed of loose strands or threads, it may also be applied to the manufacture of any ordinary form of mantle.

SWIVEL FOR HOISTING MACHINERY.—A. C. GRAHAM, Oilfields, Cal. The invention provides a pivotal engagement for uniting the hoisting cable and the elevator links of a well casing; and provides an engagement means for uniting the parts of a hoisting mechanism constructed and arranged to minimize the weight and economize the cost of construction.

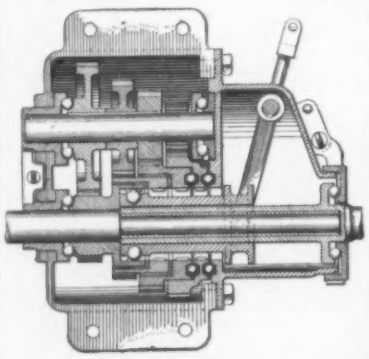
HYDRAULIC RAM CYLINDER.—O. P. BUSHNELL, care of Monarch Machinery Co., 30 Church St., New York, N. Y. The principal object here is to provide a cylinder formed from cast steel and to avoid defects incident to the construction thereof. Other objects are sought, such as forming a construction wherein the parts are stronger and lighter; and to provide a structure wherein the method of manufacturing the same is simplified.

FLYING MACHINE.—W. PHILLIPS, Edison Park, Chicago, Ill. This is an improvement in flying machines of the helicopter type, involving a vertically arranged car body within which the aviator is stationed and from which he has control of the machine by virtue of novel steering and balancing devices. The invention also includes, among other details of importance, a peculiar means for manipulating the legs upon which the device is supported when not in the air.

REVOLVER.—B. B. HOLMES, Ferndale, South Bellingham, Wash. An object here is the arrangement of a structure having a high power confined to a minimum space. Still further is the arrangement of a revolver formed so as to be held in the palm of the hand so as to be substantially hid from casual observation and adapted to be quickly discharged upon the successive closing and opening of the hand.

CHEESE MAKING MACHINE.—E. VEEMAN, Joure, Holland. By use of this machine the curd will be effectively broken up and thoroughly worked to a uniform and superior condition, the mechanism having provision for effectively extracting the whey and effecting its discharge while collecting the curd in an annular layer in the containing vessel against the inside surface of the side wall of the vessel.

CLUTCH.—J. CHALMERS, 82 River St., Quincy, Mass. This invention relates more particularly to the clutch mechanism in transmission gearing in which the rotary motion is transmitted at different speeds through two sets of gears running on parallel axes, of which gears some are loose on one of the shafts and



CLUTCH.

are provided with a clutch device for connecting them at will, so that the motion may be transmitted through any one of the gears desired, and consequently at speeds proportionate to the ratio of these transmitting gears. The novel features reside especially in the peculiar construction and organization of the mechanisms for connecting the loose gears at will with the transmitting element co-acting therewith. The engraving shows a transverse sectional view taken longitudinally through the invention.

SCALE.—C. M. STURGIS, 1601 5th Ave., Birmingham, Ala. This invention has particular relation to improvements in the construction and arrangement of parts composing a scale shown in a former patent granted to Mr. Sturgis. The principal object which the present invention has in view is to simplify and economize the construction, and with this in view it consists in providing a main rocking bar and standards therefor having knife-edge alined supports for the bar.

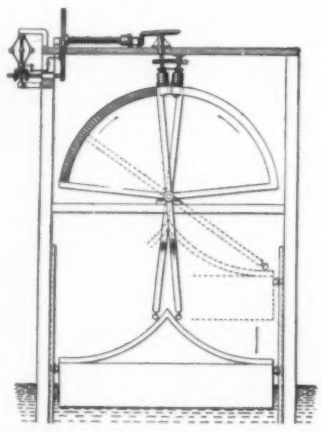
BARREL SOAKING AND RINSING MACHINE.—H. REININGER, care of Consumers Brewing Co., New Orleans, La. This invention has for its purpose the provision of a new and improved apparatus which will quickly and continuously handle barrels, kegs or the like, for washing the same automatically after the same have been once fed into the machine.

PUMP OPERATING APPARATUS.—W. ELLSWORTH, Smyrna, Wash. This invention is a means for converting rotary motion into reciprocating motion for the purpose of operating pumps and other machinery. It is especially useful for pumping water in irrigated districts, for emptying deep wells, or for supplying water from springs and streams.

### Prime Movers and Their Accessories.

ROTARY VALVE FOR INTERNAL COMBUSTION ENGINES.—H. O. WITWER, New Hamburg, Ontario, Canada. The valve is arranged to control the admission of the explosive mixture and the exhaust for the products of combustion in a simple and effective manner, to operate with uniform efficiency at all speeds, to reduce the water-cooled surface of the explosive chamber to a minimum, and to require but little power to actuate the valve.

TIDE MOTOR.—W. BRAUNSDORF, 3411 Broadway, New York, N. Y. The object here is to construct a tide motor which will utilize the buoyant force of the rising tide to lift a float, and which float during the flow of the tide will be operative through its weight to drive any suitable machinery in the same direc-



TIDE MOTOR.

tion in which such machinery will be operated during rise and ebb of the tide. The inventor intends to use this motor power to operate electric dynamo machines, which power may be transmitted through electric wires for electric lighting and for operating different elevated, surface and underground railroads, etc. The illustration gives a somewhat diagrammatic side elevation view of the invention.

CARBURETER FOR INTERNAL COMBUSTION ENGINES.—S. K. BRADFORD, P. O. Box 72, Palo Alto, Cal. This carbureter is for use with gas or petrol motors, particularly such as are used on auto vehicles and aerial machines. A feature is the automatic adjustment of the needle valve, such adjustment corresponding to variations of barometric pressure due to difference of altitude, the principle of operation being the same as that of the ordinary aneroid barometer.

MUFFLER.—V. B. STILL, 65 Baker St., Patchogue, N. Y. A principal object here is to provide for the elimination of sound accompanying the discharge of exhaust gases from internal combustion engines by absorbing the heat of the gases and thereby reducing the expansive force thereof to avoid backpressure on the exhaust of an engine of this character.

### Railways and Their Accessories.

CAR COUPLING.—B. ZUCKERMAN, 612 Eleventh Ave., Manhattan, New York, N. Y. The principal object of this invention is to provide a car coupler made up of few parts which, however, are adapted to coöperate with one another in a secure and efficient manner whereby a new and improved structure of this class is provided. The coupling is automatically performed.

TRACK ATTACHMENT FOR SWITCH SIGNALS.—G. H. RICE, care of Depot Quartermaster, U. S. A., Honolulu, Hawaii. This invention relates to safety appliances for railways, and has particular reference to devices for signaling or giving indication to the locomotive engineer of the fact of an open switch, draw or the like, which would be a menace to the train approaching the same.

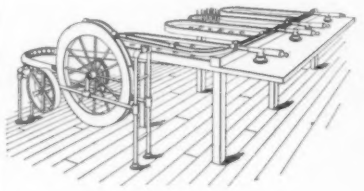
RAILROAD TIE.—J. H. MAY, 204 G. St., Napa, Cal. This tie is a shock-absorbing tie of reinforced concrete and will stand heavy traffic, and in carrying out this feature the absorber operates to absorb a large portion of the shock and this together with the reinforcement of the tie, provides one which will stand wear without breaking and will prevent rails from spreading.

### Pertaining to Recreation.

GAME APPARATUS.—E. KRANCHER, 416 62nd St., Brooklyn, N. Y. This apparatus comprises suitable devices for throwing a movable member representing a ball, and striking said member after being thrown, so as to propel it in different directions across the board; upon which is represented a base ball diamond having bases and base paths and provided with figures representing players.

SNELL FASTENER.—P. H. KLERSY, 92 Harrison Place, Brooklyn, N. Y. This fastener is provided with a spaced line retaining hooks for engagement with the line and a snell retaining hook for engagement by the loop of the snell and arranged intermediate with said line-retaining hooks and extending in a direction opposite to the one of the line-retaining hooks.

GAME APPARATUS.—A. REIBSTEIN, 48 Stuyvesant St., New York, N. Y. In this case use is made of a series of game tables shown in the illustration, an inclined runway extending in front of the tables, ball-impelling devices mounted at a right angle to the runway opposite the tables to permit of shooting a ball traveling down the runway off the latter



GAME APPARATUS.

and onto a corresponding table. Use is also made of a return chute connected at one end with a lower end of the runway and having branch chutes arranged adjacent the tables, and a driven wheel for receiving the balls from the chute and delivering them both to the beginning end of the runway. The invention relates to game apparatus in Letters Patent of the U. S., No. 1,018,343, formerly granted to Mr. Reibstein.

### Pertaining to Vehicles.

SPRING WHEEL.—F. W. BROWN, 507 Denegre Bldg., New Orleans, La. The purpose here is to provide a device which will simulate closely the action of a pneumatic tire and which has advantages that the pneumatic tire does not possess. Also to provide a wheel so arranged that portions may be easily taken apart or assembled.

WHEEL.—A. MCKILLOP, Downieville, Cal. This invention is an improvement in wheels, and has for its object the provision of a simple, strong, light-weight wheel wherein is provided a pneumatic cushion between the spindle and the tread protected on all sides from ex-

WHEEL.

ternal injury and imparting to the wheel a great amount of resiliency, while of small size and inexpensive. The accompanying illustration shows a vertical section of the invention transverse to the plane of the wheel.

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NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

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ORIGINALLY the Multigraph was simply the best means for the rapid production of form-typewriting, a whole sheet at a time instead of a character at a time. Later it was discovered that the accurate contact produced by the Multigraph took the place of the heavy pressure exerted by the ordinary printing-press; so we perfected a simple but effective printing-ink attachment.

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### How to Aid Administration

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The Multigraph Letter-Folder folds letters at the rate of 4,800 an hour—all customary folds.

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Rumely Bulletin No. 8

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See next week's Bulletin

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156 Illustrations

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## Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12730) F. D. asks: I am trying to make small dry batteries. Would like to try the formula for Dr. C. Gassner's dry battery on page 407 of your book "Experimental Science," by G. M. Hopkins, edition year 1899, and find the word plaster, 3 parts, etc., used. Now please tell me what is "plaster"? A. The formula given in "Experimental Science" for Gassner dry cells is the same as is always used in this form of dry cell. By plaster is meant plaster of Paris. This is bought dry and is stirred up with the other materials and the water when the cell is to be filled. This makes a wet paste, which while soft is rammed into the space between the zinc and the carbon. When the plaster sets, the whole is firm. This formula is a reliable formula. We do not know any better, although there are cheaper. It is also to be found in SUPPLEMENT No. 792, price ten cents.

(12731) W. T. asks: Two men circling a given point, keeping the same distance from given point. *A* moving on circle 4 feet from given point, *B* moving on circle 3 feet from given point, and always keeping given point between them. After each has circled the point once, has *A* circled or gone around *B*? A. The problem of the men going around in a circle at different distances from the center, and the question, Do the men go around each other? is very old. It has numerous forms. The squirrel on a tree trunk and the hunter walking around the tree while the squirrel goes around the trunk is perhaps the most common. The moon and the earth is exactly the same, as you see. Does the moon go around the earth, and the earth go around the moon? Astronomers answer, yes. We have always answered all these questions, Yes. The answer depends upon the answer to the question, What is meant by the phrase "to go around"? We answer that by saying that a person goes around another if he is at one time to the east of the other, and in turn passes around him so that he is to the south, west, and north, and finally is to the east of him again, whether the other party has stood still or not, then he has been around that other person. Apply this to each of the two men in your case, and if you accept our definition, you can answer the question as well as we can for you. If you do not agree with us upon the definition of going around, we shall not agree upon the answer to your question. There is no need of debate. There is only need to agree upon the definition of the terms employed.

(12732) C. C. asks: 1. How much gas is produced by one pound of carbide? A. One pound of carbide is rated to give 4 cubic feet of acetylene gas at normal pressure. 2. How much from a gallon of gasoline? A. The "gas" from gasoline as used in the gasoline engine is a mixture of gasoline vapor with common air. Very roughly, about 1,800 cubic feet of air-vapor mixture of proper composition to give good explosion power may be produced from a gallon of gasoline. 3. How long does it take for the world's population to double itself? A. It is not possible to give more than an estimate of the rate of increase for the inhabitants of the whole world, since a considerable fraction of the world's population has never been enumerated. The population of the United States increased 21 per cent in both the last decade and the one preceding the last. Figures can be given for the countries of Europe, much of South America, and for the British colonies. 4. Is there anything known that will double the yield from the land? A. A better agriculture will increase our crops immensely. We are by no means at the end of our resources in this respect. We are just starting to learn how to farm. See an article in SUPPLEMENT 1929, price ten cents, entitled "Plant Food in Relation to Soil Fertility," in which there is much valuable information. 5. If not, is there enough new land to keep the increasing population and animals in the present standard of living till the middle of this century? A. Untilled land does not bear so large a ratio to tilled land as to enable the increase of population to be provided for by bringing new land into cultivation, for an indefinite period, although the end of things is not so near as you state. 6. Or does the world grow? I think it does, because if we add layers to a ball it must get bigger, and are not the old cities, forests, etc., found deep down, grown over by falling vegetable and other matter? And does that not explain why lakes and streams disappear? Are they not filled up by this matter as the earth grows, and the water sinks in to the earth? A. The earth does not grow in the sense in which you seem to use the term. The materials which have covered forests, cities, etc., are not additions to the earth from outside, but are simply the result of changes in the materials of the earth itself, perhaps in the very neighborhood where they now are. Mountain sides are washed into the valleys by the streams, vegetable and animal forms grow, fall and decay, to be covered and forgotten, the sediments harden into new rock strata, a later age uncovers these and the cities under them, but the total material in the earth is not altered by thus shifting a small part of it about, and by the changing of it into new forms which weigh no more than the materials

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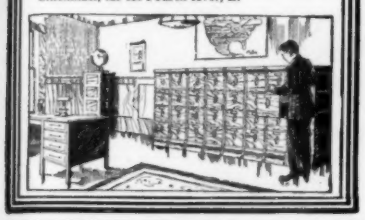

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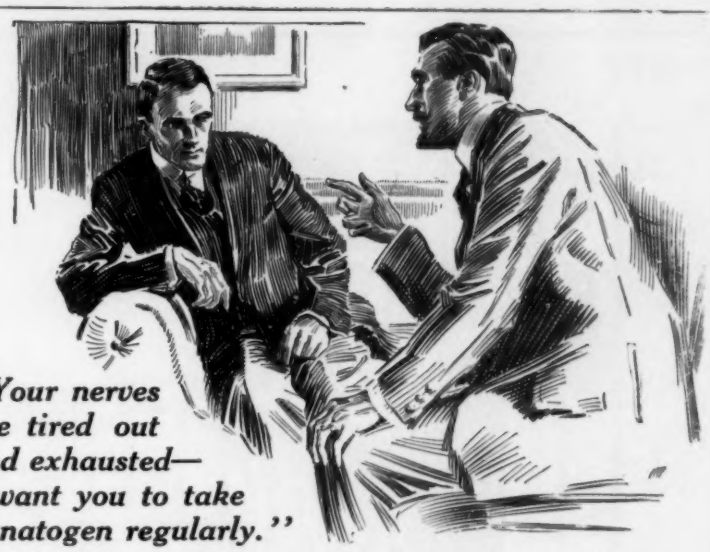
(12732) C. E. asks: Please advise us why razors and other steel tools lose their edge, and when laid aside without sharpening, seem to regain their original keenness. There has been an old saying that a razor or certain other tools, after being in use for some time, get tired, and if laid aside for a time, take on courage and can be again successfully used without practically any sharpening. Is this really so? A. We have no knowledge whatever as to the regaining of its original sharpness by a razor which, once dulled, has been laid aside. Ours do not act in that way. We have to hone them again, or send them away to be sharpened. The greater likelihood is that steel-edged tools will become dulled by rust if there is any chance of moisture being upon their surfaces when laid away. For this reason men are usually advised to hone their razors after shaving and before putting them into their cases, so that the friction of honing may dry the edges and drive off the moisture which is certainly there after using them in the lather. We cannot say that we think your theory is really so.

(12734) G. M. asks: 1. Would you kindly notify through the columns of your paper the process by which I could take photographs on paper, the same to be used as a negative from which other prints are to be made? The pictures to be small, but numerous. A. You can make negatives upon Velox and other developing papers just as positives are made. These negatives may be rendered semi-transparent by rubbing glycerine over the back, and then they may be used for printing positives, as other negatives on glass or celluloid are used. They will, however, probably show the grain or web of the paper in the positive, and not be as satisfactory as negatives made upon a film of celluloid. The ordinary Kodak film, or any other similar film, is far better adapted to the purpose than paper, and we would strongly advise against the use of paper unless you have some reason for its use which you do not state in your letters. 2. Could you also give the process by which pictures are transferred from paper to paper? I have seen a paste for doing this work, but I am unable to get any information about same. A. We do not know any process for transferring photographs by means of a paste or other adhesive to another piece of paper. If the photograph be fixed upon a card or thick paper by glue or paste, you may perhaps be able to wet the paper and rub it off with the finger, as in some other transfer processes. You will find these given in our "Scientific American Cyclopedia of Formulas," which we send for $5. We shall be pleased to receive your order for a copy. 3. Could you also give a process for fireproofing thin paper? A. Borax or alum may be dissolved and paper may be soaked in the solution, and after drying will be slow-burning, indeed, will not burn with a flame, but we do not know any mode of rendering paper non-burning, or completely uncombustible. The various methods are given in detail in our "Cyclopedia of Formulas," referred to above.

(12735) T. A. P. asks: What is the name of the largest sun in the visible universe, and what is its diameter and mass? A. No one knows which is the largest star, nor what its size may be. The distances of only about 20 stars, out of about 125,000,000 in all, are known to a certain degree of accuracy. Perhaps Arcturus is the star which suggested the inquiry to you. He is a giant among the stars about which we have the more knowledge, and is described in our SUPPLEMENT, No. 809. Other articles upon the same topic are to be found in the SUPPLEMENT, Nos. 1474 and 1658, price ten cents each. We send you our SUPPLEMENT Catalogue, which will give you the topics of many papers which you will surely find of interest. We can supply any number mentioned in this catalogue at ten cents each.

(12736) J. B. M. asks: 1. Where can I obtain an explanation of the principle on which the stereoscope works, showing exactly how the rays of light operate to make the stereoscopic effect? A. Stereoscopic views are made by the use of a camera with two lenses, as far apart as the eyes of a person. They are, therefore, the same as the views seen by the right and left eyes. These are mounted side by side on a card. The lenses of the stereoscope are as if cut from the sides of a larger lens, and are, therefore, somewhat wedge-shaped. They bend the rays of light apart, each using only the light from its own view, and in such a manner that the eyes see the two views in the same place in front of the lenses combined into one view. The textbooks of physics, used in the schools and colleges, usually have a paragraph about this instrument, with a cut showing the paths of the rays of light. You will probably have no difficulty in finding the information in some textbook or encyclopedia in the public library of your city. 2. Do you know whether there has been any successful attempt to produce the stereoscopic effect on a screen so it can be viewed by an audience? A. The pictures of the stereoscope have been many times projected by two lanterns, one over the other, but no considerable advantage seems to result, not enough certainly to compensate for the greater labor of adjusting two lanterns so that the pictures will register exactly, the one upon the other, upon the screen.

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## NEW BOOKS, ETC.

THE COMPLETE YACHTSMAN. By D. Heckstall-Smith and Capt. E. DuBoulay. With 200 illustrations in the text and 24 plates. Size $5\frac{1}{2} \times 8\frac{3}{4}$ in.; 503 pp. Price, $3.75 net. New York: Outing Publishing Company.

It does not take an expert yachtsman to realize that within the half thousand pages of this volume must be contained an answer to the thousand-and-one questions which are liable to be asked by the yachtsman for his guidance and instruction in the noblest of all pastimes. The writer has had some knowledge and experience in the owning and sailing of boats and yachts, and he did not need to read very far in the pages of this volume to realize that here was a most admirable and greatly needed work. The halftones are among the best that we have seen of notable yachts under full sail. Starting with the embryo yachtsman taking his first lesson in the rudiments of rowing and sailing, the reader is carried throughout the whole range of the subject, from open sailboats through the knockabout, the sloop, small and large, to the two-masted schooner, and is told more about their construction and handling than it is given to the average yachtsman to acquire in a lifetime. As an instance of the high quality of the book and the extremely interesting way in which technical information is imparted, we draw attention to Chapters 12 and 13, in which no less than forty pages are devoted to a detailed description of the varying fortunes of a race among first-class racing sloops over a thirty-mile triangular course. The many problems involved in the handling of a big racing cutter of the modern type are brought out in a most fascinating and readable way. Many yachtsmen will feel that these two chapters alone are well worth the price of the book.

AUS DER GESCHICHTE DER MENSCHLICHEN DUMMHEIT. München: Albert Langen, 1912.

Dr. Kemmerich has written a book which is not only an interesting historical document but a most effective piece of satire, effective because it presents incontrovertible facts in a way that sets forth most tellingly the vanities, the follies, and the mean mistakes of mankind. There is some crumb of comfort in the fact that since most of Dr. Kemmerich's instances of human stupidity are taken from the Middle Ages, we can explain them away by arguing that they were the superstitious products of superstitious times, and therefore hardly applicable to human beings of to-day. We could wish, therefore, that Dr. Kemmerich had given more modern examples of obstructions to progress. The whole literature of evolution, for example, is replete with them. To be sure, in the latter portion of his book Dr. Kemmerich does devote some space to modern superstitions. The devil, he assures us, is still the object of much concern even in the year of grace 1912. Perhaps the most shining instance of modern stupidity is that of people who bury themselves alive in order to escape the census taker. When we laid the book down we wondered whether it was not more a history of human insanity than of human stupidity.

HANDBUCH FUER HEER UND FLOTTE. Enzyklopaedie der Kriegswissenschaften und verwandter Gebiete. Herausgegeben von Georg von Alten. Berlin: Deutsches Verlagshaus Bong & Co., 1912.

Installments 49 and 50 of the "Handbuch fuer Heer und Flotte" cover the first part of the letter G. The longest discussion to be found in these two installments is that which relates to fighting (*Gefecht*). A very compact and valuable review of old and modern methods of fighting both on land and sea is here presented. Under General will be found much valuable information on such topics as General War Fund, Lieutenant-General, and other military titles in which the word General occurs. Of the geographical articles, that on Genoa is the most complete and therefore the most valuable.

TRIUMPHS AND WONDERS OF MODERN CHEMISTRY. A Popular Treatise on Modern Chemistry and Its Marvels. Written in Non-Technical Language for General Readers and Students. By Geoffrey Martin. New York: D. Van Nostrand Company, 1911. 340 pp.; 76 figures. Price, $2 net.

The sensational and the bizarre are attractive to most minds; it is very generally believed that to most minds they are injurious. It is no doubt because of these opposed reasons that the pronouncements of advanced scientific thinkers, reconnoitering beyond the outposts of learning, are read with avidity by the layman, and torn to pieces with equal avidity by scientists of more staid and sober thought. It is but seldom that a writer dealing with highly theoretical matters becomes neither a partisan nor an antagonist.

Into the realm of speculation, the reader is at once led by Mr. Martin. The excursion is an interesting one, though a trifle bewildering, since billions are about the smallest numerical magnitudes dealt with. While we perhaps differ with the author's positiveness in stating that certain so-called molecular, atomic, and corpuscular conditions and relations *are* so, rather than that they are *indicated* to be so by more or less credible evidence, we think his mass of data collected, and his manner of presenting it, of interest and of value in showing the trend of modern experimentation and the conclusions based upon it. While his applications of physico-chemical principles to the conditions of life on this earth show the wonderful inter-relation of natural laws and the needs of living creatures, the analogies between the solar system and the structure of chemical compounds suggest lines of thought that destroy inborn ideas of the permanency of the universe.

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and the language throughout is scholarly and exact. Occasionally there is a somewhat misleading lack of exhaustiveness, due beyond doubt to the author's desire to avoid confusing the reader unfamiliar with the detail of chemical knowledge. If any serious criticism is to be made, it is of the too frequent insertion of poetry in the body of the work. Vague and inexact poetical expression can seldom be useful in illuminating accurate scientific concepts.

The book will be read with interest by chemists because it carries them beyond many familiar points; the novice can read it because it will arouse his interest and hold his attention. It is in no sense a systematic textbook, it was not intended for one; but rather a stimulus to the desire for systematic chemical study.

THE CURTISS AVIATION BOOK. By Glenn H. Curtiss and Augustus Post. With Chapters by Capt. Paul W. Beck, U. S. A., Lieut. Theodore G. Ellyson, U. S. N., and Hugh Robinson. New York: Frederick A. Stokes Company, 1912.

Following the example of other designers and operators of flying machines, Mr. Curtiss has, with the able assistance of Mr. Augustus Post, given us a very readable account of his life and of his rise as an inventor of aeroplanes. In reading this book one cannot fail to be struck by the fact that Mr. Curtiss's experience in the building of motors for motorcycles and his record-breaking achievements as a motor-cyclist stood him in good stead as an apprenticeship for the career with which he was subsequently to become identified. Of technical information the book contains very little, for the very good reason that it was obviously written for the general public rather than for the constructor of flying machines. To our mind, Mr. Curtiss's principal contribution to the art of flying has been the development of the hydro-aeroplane. To him, more than to anyone else, we are indebted for a new type of air craft which promises to broaden the scope of flying and to place the aeroplane within the reach of those who would like to fly, but only if it can be done with safety. It is true that Fabre must also be considered a pioneer in this art; but we believe we are correct in asserting that to Curtiss we owe the real flying boat. It is therefore a pleasure to find that an appreciable portion of the book before us is devoted to Mr. Curtiss's work with hydro-aeroplanes.

NATURE'S HARMONIC UNITY. A Treatise on Its Relation to Proportional Form. By Samuel Colman, N.A. Edited by C. Arthur Coan, LL.B. With 302 illustrations by the author. New York: G. P. Putnam's Sons, 1912. 8vo.; 323 pp. Price, $3.50 net.

The author's thorough and fascinating research discloses a marvelous harmony among those laws of Nature which govern proportional form. Is it too much to suppose that the rules adopted by artists and architects among the ancients were based upon a close observation and a sympathetic interpretation of these natural laws as manifested in crystal, in flower, and in shell? Several interesting works tend to uphold this theory, notably those of Prof. A. H. Church of Oxford, and Prof. Raymond of Princeton University. But no work has hitherto been issued which so graphically shows the connection between the laws of Nature and Art, or which comes so near to a demonstration of the application of Nature's constructive principles to works of art. While emphasizing the element of measurement in imaginative construction, the author points out that while music is the most mathematical of all the arts, yet it is also the one which leads the mind most persistently to the highest realms of imagination and emotion. Poe said that poetry was one tenth ethical, but that the other nine tenths of the art appertained to mathematics. In the work in hand, the illustrations have been planned and wrought out with great care. The section on architecture is perhaps the most interesting, both from the value of the applications therein made, and the beauty of the illustration. The relations between the proportional dimensions of a snow crystal and those of the Parthenon are strikingly shown. Altogether the work is one of singular beauty and inspirational power.

FRESH AIR AND HOW TO USE IT. By Thomas Spees Carrington, M.D. New York: The National Association for the Study and Prevention of Tuberculosis, 1912. 8vo.; 250 pp.; illustrated. Price, $1.

HEALTH IN HOME AND TOWN. By Bertha Millard Brown, S.B. New York: D. C. Heath & Co., 1912. 8vo.; 312 pp.; illustrated. Price, 60 cents.

In this time of awakening to the advantages of outdoor life, and the growing prevalence of outdoor sleeping, "Fresh Air and How to Use It" will appeal to a wide circle of readers. It contains chapters on ventilation, on wall houses and iron-frame porches for city use, on permanent sleeping porches and loggias and the methods of protecting and screening them, and on tents and tent houses. There are many illustrations, showing all manner of devices for securing fresh air, particularly during sleep. The final chapter discusses clothing, bedding, and furniture, with the various forms of sleeping bags and tent cots. "Health in Home and Town" is, as its title would indicate, a little broader in scope and a little less detailed in description. Besides the matter of securing fresh air both night and day, it takes up such important features of our lives as running water in the home, methods of heating and lighting, the care of the home, parks and playgrounds, food supply, city water and ice, refuse, dangerous diseases, and the prevention of disease, particularly of tuberculosis. Both books may be commended to those who would improve the conditions of life and raise the standards of health and happiness.


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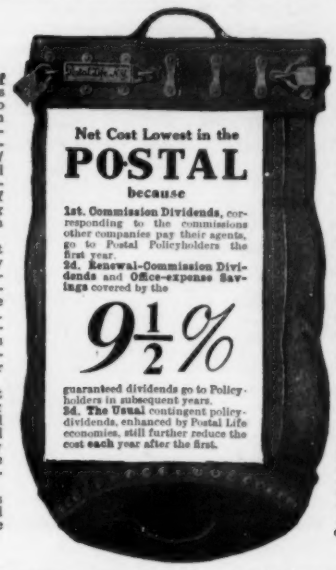
The examination covers many pages of a printed document on file at the State Department.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**Scientific American, No. 23, Vol. 104** describes Jarman's Engine, on the sliding-valve principle.

**Scientific American, No. 14, Vol. 106** describes the Augustine Rotary Engine, with novel features incorporated in the sliding-valve design.

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## "The Whip" and Its Mechanism

(*Concluded from page 85.*)

lar device is in use on the other side of the stage to give the effect of the exhaust of the automobile which is racing to save the life of the precious horse. The steam exhausts into a large packing box, and the effect is very realistic. There are electric lights at intervals along the track, which are flashing in succession, thus giving the effect of the light from the cars on the rails. A moving panorama at the back rounds out the illusion. The tunnel consists of a black cloth scene, and it is set, in semi-darkness, by men who wear black smocks so they will not be seen by the audience. This is a variation of the well known trick called "Black Art." When the locomotive is pushed forward by the men propelling it, it is run up on an interrupted inclined plane. The slats which have been removed at the top of the plane leave an aperture which receives a false wheel in the center of the locomotive that thrusts it over to one side. The locomotive, which is built of wood, is piped so that steam comes out of the stack, fire-box, and underneath. At the moment of the crash a bomb is exploded in the box car, and it is promptly broken by men who pull lines at a signal.

The scene gives an admirable idea of what English rolling stock really looks like from the outside; but the privileged few who have been taken behind the scenes and ridden in the coach (a much sought for privilege) will all concur in saying that there is no coach in England as hard and unyielding as in this theatrical property. It would almost appear preposterous to those who have not been abroad, or have seen the play, that an evil-minded person could emerge from his compartment and creep along the footboard to work such mischief, but some of Europe's most atrocious crimes have taken place in railroad passenger carriages of this type.

"The Whip" was sent to Newmarket by another train, and after strenuous unsuccessful attempts to prevent her being ridden by her own jockey, the actual race takes place. The stage has been cleared of scenery, and those who have taken part in the mob scene gradually edge off to left and right. The stage is darkened for a moment; the curtain is raised; and the audience sees for a brief moment a most exciting race. There are eight horses in the race, but there is a chance for only two of them to win, as the others are held in position by iron rods which prevent them from actually progressing across the stage. In order to give a life-like appearance, they run on treadmills, which are flush with the floor of the stage. The treadmills of "The Whip" and her nearest competitor are mounted on rollers and are adapted to move across the stage in a channel which is provided by removing sections of the flooring. Two men in the cellar receive a cue from a man who is watching the race through a hole in the floor, and at the proper signal they both turn their winches, and at another signal the removable platform on which "The Whip" is speeding is drawn forward past the winning post, which is mounted on rollers and is pushed back at the critical moment by a man who stands behind it. He is masked by a black background, which serves to bring out the winning post in relief. The panoramas, which run in the opposite direction to the race, are extremely ingenious. The large panorama is fixed and occupies the back of the stage, and this is driven by a 35 horse-power motor in the cellar. The other four panoramas, however, which prevent a sharp line of demarkation, can be pushed around into position; and each of these four panoramas is actuated by its own motor. The five panoramas are all controlled through one switchboard, so that they are all moved in unison.

The horse race on the stage is not a new thing, by any means, the first of such devices being used many years ago in a melodrama called "Paris Port de Mer." Neil Burgess obtained a patent on the mechanism for accomplishing this effect, and it was also used in "Ben Hur." It was found in "The Whip" that by sinking the treadmills so they are flush with the stage, it was not essential to run moving belts in front of the treadmills, as was necessary even at Drury Lane. The idea of having the small portable panoramas is a very good one, as it adds a great deal to the realism.

It is very unusual to get permission to illustrate stage mechanism by actual photographs, and we are indebted to the Drury Lane Company of America; its directors, William A. Brady, F. Ray Comstock, Morris Gest, and Mr. Arthur Collins of London, with whom special arrangements were made; and Mr. Ben H. Atwell, who conducted the negotiations.

## The Mercy of Steel and the Menace of Wood

(*Concluded from page 88.*)

picture of those which we present is illustration No. X., showing a steel day coach after it had assisted in completely demolishing the two wooden cars to the rear and in front of it. This car passed through the frightful collision on the Delaware, Lackawanna and Western Railroad, near East Corning, New York, on July 4th, 1912, when an express train, disregarding the distance and stop signals, crashed at sixty miles an hour into the rear of an express train ahead of it. The energy of the colliding train was expended mainly on the last three cars of the train ahead. The rear car was a wooden day coach, the next was a steel coach, and ahead of that was a wooden sleeping car of very strong construction. The flagman of the stalled train went back some two thousand feet from the rear of his train, put a lighted green fuzee on the end of the tie on the engineman's side of the track, waved his flag, but did not, as he should have done, place any torpedoes on the rail as required by the rules during foggy or stormy weather. An eight-car express train, running sixty miles an hour, swept round a curve, disregarded the distance and home signals, the flagman's flag, and the green fuzee, and swept straight ahead. The engineer was busy with his injectors, which were out of order, and when he passed the flagman, was observed to be looking not ahead but across the boiler. The rear wooden car, caught between the upper and nether millstones of the engine and the steel car, was reduced to matchwood, as shown in illustration No. IX. In acting as the anvil for this mighty blow of nearly 70,000 foot-tons, the steel car suffered no worse injury at its after end than the crushing in of the platform. Driven forward by the impact, it reduced to unrecognizable wreckage no less than two thirds of the heavy sleeper ahead. In doing this, it suffered the injury shown at the left end of the car in illustration X. Beyond the fracture of windows, the main body of the car, as can be seen from the photograph, is practically intact.

An automatic stop, set 1,000 feet back from the home signal, would have averted this wreck, in which 49 people were killed and 88 injured.

Summing up, then, we may say that the lessons taught by the accidents we have had under review are mainly three: First, the imperative necessity of changing the practice of our rail mills so as to absolutely eliminate rails that are piped or otherwise defective; second, the substitution, as quickly as financial and other conditions will allow, of steel for wooden cars; and, last, the universal adoption, in connection with the present block signal system, of the automatic stop.

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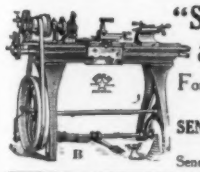

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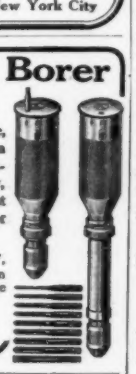

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## The Mysteries of Artesian Wells

ARTESIAN basins, or the underground water supply which furnishes artesian wells with their constantly flowing streams, sometimes spouting to a considerable height above the surface, are often popularly referred to as "subterranean rivers," which are believed to "flow" at great depths, eventually finding their way to the surface to feed some visible stream. Or, they are thought to exist as great caverns or reservoirs, deep down in the earth, which if tapped by the drill furnish the tremendous flows of water which characterize some of our largest artesian wells—several hundred thousand, and even in some cases half a million gallons a day. It is true that artesian waters are stored up in underground reservoirs, but they are not of this character. Most artesian water supplies consist simply of water-filled strata of sandstone or other porous rock material, through which the water very slowly percolates, confined from above and below by other strata of impervious rock or clay. Through this inclosed layer of porous rock the water works its way with infinite slowness, following the dip or slant of the rock, and where tapped coming to the surface, if the surface at this point be below the source of the supply. Coarse sandstone is capable of holding a great quantity of water, as much as 6 quarts per cubic foot; but the rate of its movement through this rock is so slow as to be almost inappreciable.

To illustrate how slowly the water travels: Many artesian, or flowing wells are found along the Potomac River at Colonial Beach and other points in Virginia, about 60 miles south of Washington. This water is obtained by drilling into a sandstone formation which extends along the Potomac Valley and into Maryland and outcrops near Frederick, Maryland, some 50 miles north of Washington. It takes about 100 years for the water of this "subterranean river" to flow that distance; that is, the rains falling upon the exposed portions of the porous rocks near Frederick sink in and move southward at the rate of about 1 mile a year. The water issuing from the wells at Colonial Beach to-day fell as rain on the uplands and mountains of Maryland around about the time that Washington was President of the young American Republic.

## Ozone as a Rapid Paint Dryer

PAINT drying has no connection with the evaporation of water—in fact the weight of the painted surface increases in drying. Paints are mixtures of insoluble pigments or coloring matters with some drying oil, generally linseed. When exposed to the air the oil absorbs oxygen and is converted into a smooth elastic mass called "linoxyn."

To hasten this drying process the oil is frequently boiled before mixing with the pigment. Lead oxide, manganese dioxide or metallic salts are added in the boiling process to start the drying or oxidation of the oil. The oxides give up their oxygen, but the salts act as oxygen carriers. The most recent accelerator used in paint drying is a blast of ozonized air. Ozone is only a more active form of oxygen obtained by passing air through the "silent discharge" of a high voltage electric current leaping across a gap. Machines are on the market at a low price that furnish large quantities of ozonized air and the cost of operating is no more than for one or two sixteen candle-power lamps. They are portable and easily attached to ordinary lighting circuits.

Since ozone oxidizes with enormously greater speed than oxygen its value in paint drying is evident. In the painting of automobile bodies hurried drying is demanded by the crowded condition of the factories. Recent tests with ozonized air showed after two hours an increase in weight of the painted body of 3.34 per cent, while with ordinary air the corresponding increase was only 1.51 per cent. This increase was due to the absorbed oxygen and fairly measures the relative rapidity of the two drying methods.


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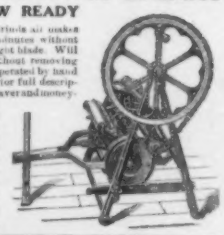

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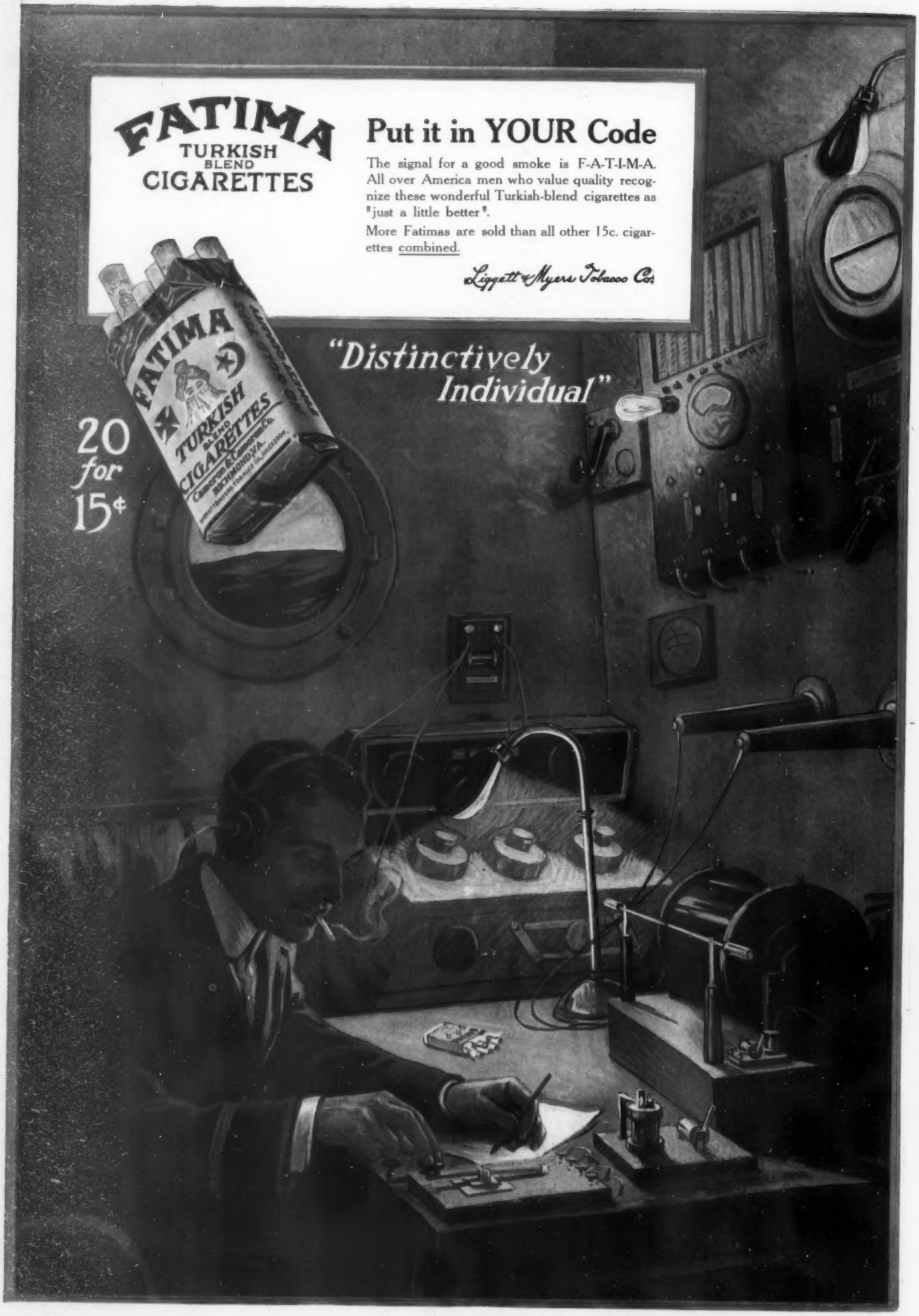
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